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To my wife Jennifer and my parents Malcolm and Peggy Wardlaw.

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Essays on Banking and Corporate Investment

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This dissertation examines issues in banking and the financing of corporate investment. The first chapter investigates the impact of changes in a bank's health on the investment behavior of its current borrowers for a panel of U.S. firms. I find that, after controlling for aggregate credit availability and the condition of outside banks, firms reduce their investment when the health of their primary bank deteriorates. This effect is only present while the firm maintains a borrowing relationship with the bank and does not appear to be driven by changes in region or industry specific investment opportunities. The health of the existing lender is more important for younger, more opaque firms with greater reliance on their primary bank. I also find that this effect became less significant after the early 1990s, suggesting that bank dependence appears to diminish during long periods of stability. However, results from the recent financial crisis show that healthy banking relationships remain very important to U.S. firm investment.

The second chapter, adapted from joint work with Richard Lowery, examines the determinants of covenant structure in private debt contracts. While previous studies have demonstrated a relationship between firm characteristics and the overall strictness of loan contracts, few studies have examined why covenants are written on a range of accounting variables and what determines their selective use. Using a simple model of firm investment where firms face uncertain cash flows and investment opportunities, this essay characterizes the conditions under which it is optimal for a debt contract to specify a restriction on investment or to specify a minimum cash flow realization.

Consistent with this model, empirical evidence demonstrates that the application of covenants based on these variables is not necessarily monotonic in firm risk. While the financially riskiest firms tend to employ capital expenditure covenants, cash flow and net worth covenants are most common among moderately risky firms with greater profitability and firms with stronger baking relationships. The results also highlight the importance of debt covenants in both mitigating agency frictions and maximizing the value of future private information.

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Chapter 1

The Impact of Bank Health on the Investment of Its Corporate Borrowers

1.1 Introduction

The investment capital supplied to firms comes from a variety of different providers. Under the Modigliani and Miller (1958) assumptions, not only the contractual type of capital, but also the source of capital is a matter of irrelevance. Disruption to one provider of capital does not affect the firm's investment decision, since the firm can always costlessly substitute to another provider. In practice, asymmetric information frictions, search costs, and transactional barriers can make switching costly. When frictions are severe enough, disruptions to a source of capital can prevent firms from undertaking new investment.

Firms which rely heavily on banks to finance their investment face an especially high risk of disruptions to their financing. Banking relationships have important benefits, but they also concentrate information about the borrower in the hands of its current bank. Since this information is nontransferable, the firm may face higher borrowing costs from new, uninformed banks who must invest time and resources to become similarly informed. Moreover, the information advantage held by the current bank creates an adverse selection problem for uninformed banks (Rajan, 1992; Sharpe, 1990). If new lenders cannot distinguish between an inability and an unwillingness to lend, they may be reluctant to recapitalize the clients of the current, informed bank. As a consequence borrowers may become capital constrained by a shock to their current bank even if other banks remain healthy.

This paper investigates whether shocks to the health of a bank have an effect on the investment of its existing corporate borrowers. I focus on the health of individual lenders connected to firms through specific banking relationships, holding the aggregate health of the banking sector and the overall supply of capital fixed. This allows me to investigate whether idiosyncratic shocks to a particular bank can impact the investment of its existing borrowers, even when other unaffiliated banks are not affected in the same way.

To explore the importance of bank health on corporate investment, I examine a 20 year panel of borrower-lender relationships from 1988 to 2007. I find that an increase in the bank's non-performing loan ratio is associated with a significant decrease in future investment by its existing borrowers. Specifically, a one standard deviation increase in the non-performing loan ratio (an increase of around 2%) reduces the average annual investment of firms which borrow from that bank by 8 to 10% in the following year. This directly establishes investment distortion as one of the costs of bank dependence and highlights the importance of bank stability in the financing of corporate investment.

There are, of course, endogeneity concerns that must be addressed in this analysis, resulting from both potential simultaneity and an omitted variable bias. To address these concerns, I use panel data techniques to isolate the variation in bank health that originates with the bank and is specific to the firm through a banking relationship. First, I measure individual bank health as a function of the lagged non-performing loan ratio. By excluding any borrowing firm that is non-current on their debt obligations, I eliminate any *direct* simultaneity problems that may contaminate the variable of interest, as no firm action is directly impacting the non-performing loan ratio of its matched bank observation.

A more significant endogeneity question, technically a strong form of omitted variable bias, is the extent to which both banks and firms are jointly affected by common macroeconomic shocks. Viewed in another way, we should be concerned that banks may specialize in lending to certain types of firms, and when these type of firms do poorly, the banks will also underperform. To address this problem, I isolate the cross-sectional variation that exists due to the unique firm-bank relationship. I model this by including groups of time specific fixed effects. Since my panel spans multiple years, I effectively control for all macro level changes in a given year by modeling them as a common effect. The remaining variation then identifies the differences between firms whose banks have suffered different shocks as a result of their other banking operations.

I show that the results hold almost identically after controlling for time-varying industry and regional economic conditions, using more stringent category-time fixed effects. This identifies the effect from the residual differences within industry or region within each year. Under the assumption that at least part of the cross-sectional variation is due to geographic or industry concentration in bank portfolios, this demonstrates that the variation which drives my main cross-sectional results is largely orthogonal to shared economic conditions. I also show that the results hold equally well, and in some cases stronger, when the firm operates in a different geographic region than its bank. Lastly, I demonstrate that the results hold only for firm-bank pairs with a current lending relationship and fail to hold in other periods wherein the bank was not the firm's primary lender.

Under the null hypothesis, where the observed correlation was being driven by endogenous economic factors, each additional set of fixed effects should substantially reduce the magnitude of the coefficient. Similarly, the out of sample tests should produce estimated correlation coefficients under the null that are at least close to the in-sample coefficients. Taken together, the empirical results suggest that I am able to gain substantial identification from the residual components of bank distress which are unrelated to the performance or investment opportunity set of the sample firm.

In addition to establishing the presence of bank effects on firm investment, we may be able to learn more about the importance of banking relationships by examining the differences across groups along theoretical grounds. The main reason that firms may have difficulty switching banks when their primary bank becomes distressed is that banking relationships are informationally sensitive. Banks create value in financial markets by screening and monitoring their clients, which may require a significant up-front investment by both parties. More importantly, a firm with an existing banking relationship faces an additional adverse selection cost when trying to form a new relationship, because the current lender possesses private information about the firm's current prospects (Rajan, 1992; Petersen and Rajan, 1995).

Consistent with such lock-in arguments, I find that the sensitivity of investment to lender health is stronger for more informationally sensitive firms and stronger for firms with fewer outside borrowing options.

In addition to the cross-sectional differences, I also examine the variation in time-specific subsamples to address the question of how the firm-bank link has changed since the late 1980s. Specifically, I test the conjecture that firm investment in the U.S. has become less dependent on bank health over time. The past 20 years has seen a shift away from traditional relationship based banking towards a more arm's-length, transactional model. In light of these changes, many researchers and industry experts have suggested that the importance of individual bank relationships have declined in the United States. Consistent with this view, I find that the effect is most concentrated in the first half of the 1990s, likely as a consequence of the large scale variation in bank instability during the period, and appears to steadily diminish in statistical significance up until the most recent period. Increased stability in the banking sector, along with a more arm's-length role of bank lending, may have decreased the relative importance of bank relationships during that time. However, results from the most recent period show that this trend, if it existed, may not be as permanent as previously thought. I find a substantial increase in the average effect for the most recent period, 2006 to 2009, relative to the previous 10 years. This adds to the growing body of evidence that the lack of access to bank capital is one of the central problems of the most recent financial crisis.

The issue of banks impact on corporate investment is especially relevant given the current debate about the impact of bank instability on economic growth. It remains a hotly debated question as to whether the massive contraction of bank lending in 2008 and 2009 caused an inefficient decline in corporate investment, or if corporate borrowing simply declined as a result of decreased demand for capital.[1] It is difficult, if not impossible, to tease out this effect by examining the aggregate time-series, but it may be possible to learn something from information in the cross-section. If firms tied to a particular distressed bank cut investment relative to their peers, it is reasonable to assume that a similar effect exists for the corporate sector as a whole relative to some efficient benchmark. By extension, this paper provides some indirect evidence that the banking crisis which began in 2007 did have a real, distortionary effect on corporate investment.

This paper is related to several different strands of literature in banking and financial intermediation. Early work by Diamond (1984), Fama (1985), and Bernanke (1983) emphasize the role of banks in resolving asymmetric information problems, lowering the cost of capital, and making bank capital unique from arm's-length debt. Rajan (1992), Petersen and Rajan (1995), Diamond and Rajan (2001) further demonstrate how these relationships can also impose ex-post costs on the borrower once the bank gains an informational advantage over its competitors. This paper demonstrates a significant impact of individual bank health on real firm investment and highlights the uniqueness of informed bank capital. By isolating the effects of existing lending relationships in particular, I also provide indirect evidence of the potential

[1]This question is heavily debated in the popular press as well as academic circles. See, for example *The Wall Street Journal*, April 20, 2009, "Bank lending keeps dropping; analysis of treasury data paints starker picture than official government snapshots." and related letter "Bank lending responds to demand" *The Wall Street Journal*, Letters to the Editor, April 28, 2009.

bank lock-in effect implied by these theories. I further show that the impact is larger for firms with greater informational asymmetries and less available collateral, supporting the theory that this lock-in effect is related to information costs.

This study contributes to a body of empirical work that examines bank health and firm borrowing. While my paper is similar in spirit to many of these studies, it serves to fill in a number of important gaps in the literature. Studies such as those by Paravisini (2008) and Khwaja and Mian (2008) have identified cross-sectional changes in capital availability and net lending to existing customers surrounding major banking crises in Argentina and Pakistan. The implications of these studies are somewhat limited, however, in that these countries have a less competitive banking sector with less developed bond markets. They also don't directly examine whether these financing expansions and contractions have an impact on firm-specific investment, especially in the context of pre-established lending relationships.

In addition to changes in the amount of corporate lending, several studies have shown that bank health affects the terms of lending. Lown and Peristiani (1996), Hubbard et al. (2002), and Santos and Winton (2009) find "bank effects" in loan pricing, where the financial condition and informational advantage of the lender affects the spreads charged on new bank loans. The fact that these financing effects are persistent implies that the firm's existing banking relationship is not entirely fungible, and that deterioration in the health of the bank creates a meaningful financing friction ex-post. My paper seeks to verify the existence of these ex-post frictions, and provide evidence of whether this lock-in effect actually generates meaningful distortions in ex-post firm behavior.

To investigate the net impact of these financing frictions, much of the literature has centered on event study methodologies. By examining the stock price impact of specific bank distress events on individual borrowers, these studies quantify the impact of bank relationships of valuations. Examples include work by Slovin et al. (1993), Cosimano and McDonald (1998), Kang and Stulz (2000), Bae et al. (2002), Ongena et al. (2003), and most recently Chava and Purnanandam (2010), who examine the Russian financial crisis as a shock to bank dependent firms and use the cross-sectional variation in bank exposure to further identify the effect. While these event studies do provide a relatively clean identification of the impact on short term value, they do not examine the real effects on subsequent firm behavior. Moreover, while these results suggest that isolated banking shocks may create a temporary increase in the cost of capital that is impounded into the stock price, it remains an open question as to whether these shocks significantly impact the investment decision of the firm.

While the effects on cost of capital, financing decisions, and valuation are important, the more fundamental question is whether bank health has a real effect on investment decisions of the firm. Focusing on real investment, this study most closely resembles the work of Gibson (1995) and Klein et al. (2002), who measure the effect of Japanese bank health on the investment behavior of their clients during the early 1990s, and Peek and Rosengren (2000), who examine the cross-sectional differences in real estate investment across states with Japanese branch banks. While complementing their results, this work also differs significantly in its scope and economic implications. Japan's economic model is much more bank-centric than that of the

United States. While this has a lot of benefits for empirical research, it is also has limitations, since it is difficult to generalize the results to market oriented countries. By matching across three different data sets, I am able to get detailed information about firms and banks in the United States and estimate the extent of banking relationships for a large number of U.S. firms. In doing so, I demonstrate that shocks to bank health have a significant impact, even in market oriented countries like the U.S.

A contemporaneous working paper by Lin and Paravisini (2010) examines several policy decisions of U.S. firms whose main lenders were adversely affected by the collapse of WorldCom in 2002. Using this event as a single, plausibly exogenous credit shock, they find some evidence that certain types of firms reduced their investment in the six month period after this event. This paper is complementary to these findings and provides evidence that this impact is pervasive. While they focus on a single credit event, I examine a broad panel of firm-bank relationships spanning over 20 years, and I focus on more general investment implications of bank relationships without placing the same conditional restrictions on the time period or event. My long sample period also allows me to examine how this effect has changed over time, providing important evidence on how this effect has evolved with the changes in U.S. banking and under what conditions it is most important.

The paper is organized as follows. Section II presents the data and the details of the sample construction. Section III describes the identification strategy and presents initial evidence for the proposed link between bank financing and investment. Section IV presents and discusses the main investment results. Section V examines the cross-sectional and time-series differences. Section VI concludes.

1.2 Data and Sample Construction

1.2.1 Data Sources

To examine the link between firm investment and the health of its main bank, I first have to identify which bank is the firm's primary lender during any given period. For firms in the United States, this is difficult to observe directly since firms do not ordinarily disclose their primary banking relationship and, unlike Japan, no institutions exist to formalize this relationship. Ideally, I would want a self-reported list, from each firm, of both the bank they consider to be their primary lender in each year and the total amount of outstanding debt held with each lender. Since I cannot observe this information directly, I use available data on major new loans to construct an estimate of the strength and duration of these relationships.

To do this, I combine data across three different databases. The first is the Dealscan database of commercial loans, provided by the Loan Pricing Corporation. This database lists loans to various corporations from 1988 to early 2007 as well as various details about the credit facilities. While this database does not contain all loans made, it does record the majority of all major new loans made to public firms in the United States. According to Carey and Nini (2007), Dealscan has information on 50-75% of all U.S. commercial loan volume into the early 1990s, with coverage increasing to 80 - 90% from 1992-2002. The database contains information such as the dollar amount of the loan, the maturity and interest rate spreads on each loan, and select information about the type, purpose, and contractual terms contained in each loan. Data is available from 1988 to early 2007, and the database becomes progressively more comprehensive during later periods.

Using the name, ticker symbol, dates of operation, and observed loan sizes, I match the borrowers of each loan to CRSP-Compustat. I then use the name, location, dates of operation, and loan size information to match the lenders to the quarterly Call Reports data provided for all chartered U.S. commercial banks. This data comes from the required quarterly submissions of financial status for all chartered banks that fall under the jurisdiction of the Comptroller of Currency or the Office of Thrift, and it is made available by the Federal Reserve Bank of Chicago. In addition to these data sources, I also obtain contextual data on corporate filings from Factiva and SEC-Edgar to verify the status of each company.

1.2.2 Panel Construction

The matching procedure establishes a one-to-many link between each firm and lender for a given credit facility. A firm may, and often does, have multiple credit facilities from the same bank within the same month or year. Each firm also often borrows from multiple banks and has outstanding loans from multiple different creditors at any given time. Using the effective start date and maturity of each loan facility allows me to create an overlapping timeline of lending relationships for each individual company to which a bank can be successfully matched.

For each firm-year, I take the total estimated outstanding loan amount and determine which lender holds the largest proportion in each year. This requires estimating the total share of the outstanding loan balances for each period held by each matched bank and calculating the largest lender for that period.

For example, assume a firm with no outstanding loans takes on Loan 1 during year t for $1 million, which matures during year t+3, prior to the end of the year. For simplicity, we will assume that each loan is paid in full only at maturity. At the end of year t, t+1, and t+2, the firm is estimated to be holding $1 million from this loan. If Loan 2 is then initiated during year t+2 for $4 million, the estimated total outstanding loan amount for the firm at t+2 is $5 million. If Loan 1 is funded entirely by Bank A, then Bank A is recorded as holding 100% of all outstanding loans at the end of year t and t+1, making Bank A the firm's primary bank. If Bank B holds 75% of Loan 2, then Bank B is recorded as holding $3 million of all outstanding bank debt at t+3 (60%) and replaces Bank A as the new largest lender for subsequent periods.

The process detailed above yields a panel of firms with an approximation of their outstanding loan balance in each year. This panel is unfortunately unable to distinguish, except in a few specific circumstances, if any of the outstanding loans were terminated early or refinanced by a new loan. This procedure may overestimate the strength of a given lending relationship where this is the case. To deal with this, I apply some basic screens to each observation. In particular, I require that the total estimated outstanding bank loans cannot exceed the total debt liabilities of the firm as recorded by Compustat, and the estimated total amount pledged to a particular firm cannot exceed the capital of each bank. While these screens do not fully eliminate this type of error, classifying a banking relationship as stronger than it actually is should bias against my hypothesis.

I am unable to match a lender wherever a firm's primary lender is a foreign bank or a non-bank financial institution, and the firm is not included in the sample. This yields a number of periods where the firm's largest lender is not identifiable, even though it has outstanding loans from one or more commercial banks. When the largest lender cannot be successfully matched to the call report data, I retain the second largest debt holder that can be successfully matched. This produces a rough estimate of each firm's primary banking relationship in each year, in terms of which bank holds the largest fraction of the firm's institutional debt. As this matching process is quite coarse, I do not place any pre-conditions on the structure of the debt that identifies the relationship. The issued debt which establishes the relationship may be a long term amortizing loan or a revolving multi-year facility, though most relationships are established by a mix of both. Since the actual holdings are estimated with a fair amount of noise, the purpose of the matching criteria is not to explicitly classify the full exposure of each bank to each firm, but simply to identify which bank is most active in providing debt capital to the firm at a certain time.

This procedure generates a single time-series for each firm where the status of the largest recordable loan holder is matched to the firm. The resulting panel, with unique observations for a given borrower at any point in time, is matched to the firm and bank data provided by Compustat and the Call Reports. To avoid measuring effects which influenced the initiation of the banking relationship, I remove all observations where the bank initiated a new primary banking relationship in the past year, since bank health is measured as of the beginning of the year. Thus, for all firm-bank pairs in the panel, the firm has had an established lending relationship with that bank for at least a year. I also remove all companies who were in default on any rated credit obligations or reported themselves as non-current with existing borrowing obligations, public or private, during any period.

1.2.3 Summary Statistics

Variables are constructed from Compustat, Dealscan, Call Report information, or a combination of the three. To remove the presence of extreme outliers, I trim investment, cash flow, Q, and Altman's Z-score at the 1% and 99% levels. To verify the proper bank and borrower identification, the estimated outstanding loan balance must be less than the total outstanding debt of the firm as recorded by Compustat. I omit all financial and real estate firms as well as all regulated utilities.

The final sample consists of approximately 4,300 observations containing 1,370 unique firms and 140 unique banks, spanning from 1987 to 2008. Summary statistics are reported in Table 1.1. Firms in the sample tend to be larger than the average Compustat firm but similar along most other dimensions. Importantly, the sample is also diverse in terms of industry and geography. Firms in the sample have headquarters located in 49 different states and represent all 28 of the remaining 30 Fama-French, excluding financials and utilities.

The commercial banks in the sample are quite large, with a mean bank size of over $100 billion in assets. The average bank size has also changed quite radically over the 20 year sample. Prior to 1990, the top three banks in the sample recorded between $80 to $160 billion in total assets. With the wide spread consolidation in the banking industry over the last 10 years, the largest three banks have well over $1 trillion in assets in 2008. The average primary banking relationship lasts around 4.5 years.

1.3 Bank Health and Firm Investment

1.3.1 Identification Strategy

Since much of the empirical analysis in this paper deals with addressing questions of endogeneity, it is useful to explicitly define what it means in the context of my analysis. This may also help to pin down exactly what is being identified through my testing strategy, and how it should be interpreted. Formally, endogeneity is the statistical condition where the error term in the "true" model is correlated with the regressors. Since standard regression techniques assume the error term to be uncorrelated and force the underlying residuals to be orthogonal to the regressors, the standard approach will produced estimates which are biased. From a practical standpoint this means that, when estimating the effect of economic phenomenon which may be jointly determined, isolating the sources of variation becomes extremely important.

In addressing these concerns, it is useful to precisely identify the sources of endogeneity. The first source of endogeneity, which is often the most focused on, is reverse causality. This is commonly observed when the underlying economic driver of the dependent variable, Y, feeds into the independent variable, X. Since a change in Y can drive a concurrent change in X, the effect of an independent change in X on Y is mis-measured. In the context of bank distress and firm investment, one can think of this problem in the following way. Borrowing firms which are performing poorly take a number of actions, including reducing investment and potentially defaulting on their debt obligations. If banks are facing high defaults from their borrowers, then they become distressed as a result. Thus, any measure of bank distress which is contaminated by the default (or potential default) of the observed firm will cause the effect of bank distress on investment to be mis-measured.

The second source is one in which the model specifies Y as a function of X, but where both the X and Y variables are jointly determined by common economic drivers that may not be fully observable. This is commonly referred to as the omitted variable bias. This interpretation is related to, and sometimes confused with, the reverse causality problem, in that the coefficient estimates are picking up a misidentified source of variation. However, identifying this source of endogeneity apart from the simultaneity concern highlights the measurement problem more succinctly. It is not enough that, for each observation, the value of Y (the distress of the firm's bank) is not directly effected by the change in X (the condition of the firm). If both the distress of the bank and the condition of the firm are driven by common changes in the economic environment, the estimated coefficients will still be biased.

My identification strategy hinges on the the fact that I can uniquely identify a firm-bank relationship on a one-to-one basis through time. I can address the reverse causality problem directly, by verifying that the sample firm is not itself impacting the health measure of its matched bank. Using panel data estimation techniques, I can employ a number of strategies to address the omitted variable problem. Firm-bank fixed effects isolate the within relationship variation, sweeping out the cross-sectional mean differences in firm and bank characteristics and isolating the investment effect from the criteria that influence the initial firm-bank match. More importantly, with a continuous, bank-specific measure of distress, I can employ time fixed-effects, isolating the investment impact from common economic changes in the macroeconomy. Thus, I identify the impact of bank health which arises from differences *between* banks at each point in time, holding fixed the health of the banking sector as a whole. Using geographic and industry specific time-effects allows me to further isolate the variation and identify the effect from variation that comes solely from differences within a certain region or industry at a particular time.

1.3.2 Determinants of Bank Health

Existing banking literature largely relies on three measures of bank health. Broadly speaking, these are equity capital ratios, the nonperformance of existing loans, and the bank's debt rating.[2] From a theoretical perspective, each of these commonly used measures proxies for the ability of a bank to make new loans from existing funds or new capital. Since a bank must raise funds it lends out from depositors or security investors, anything that significantly impairs this process will prevent the bank from functioning efficiently. Regulatory restrictions force banks to maintain certain levels of non-deposit capital, causing distressed banks to restrict lending or raise new equity capital.

Since non-deposit capital is uninsured, its issuance is subject to adverse selec-

[2]Since this study is focusing on individual banks, many of which are not publicly held, the use of debt ratings is beyond the scope of this paper.

tion problems which make it proportionally more expensive (Stein, 1998). Outright bank failure, where the bank becomes completely unable to recapitalize and collapses, represents the most severe case of this problem. Barring an unexpected run on deposits, nonperforming loans are usually the most important determinant of this, since they must be reserved for, reducing loanable funds. Thus, nonperforming loan ratios proxy for the ability of banks to continue future operation in the face of capital constraints.

The lending response of banks to these capital constraints has been documented in several ways. A number of studies have demonstrated a decrease in the total quantity of corporate lending from banks facing a liquidity shock. Khwaja and Mian (2008) demonstrate that banks reduce their commercial lending to existing customers when faced with an unanticipated liquidity shock. Conversely, Paravisini (2008) shows, through the exogenous component of a formula based allocation of government funds to Argentinean banks, that banks expand commercial lending in the face of positive financial shocks. This is consistent with the evidence provided by Peek and Rosengren (2000), who identify a connection between the declining health of Japanese banks in the 1990s and their individual reduction in U.S. real estate lending.

Deteriorating bank health also has important reputation effects which may exacerbate the existing liquidity issues. A recent working paper by Gopalan et al. (2010) shows that banks experiencing portfolio defaults are less likely to syndicate a loan and less likely to attract lenders to participate in its syndicates. This suggests that banks who rely on syndication to fund a large portion of their lending are directly and indirectly affected in their ability to lend. Firms which rely on these lead lenders are exposed to contractions in lending by the less informed syndicate participants as well as their lead banks.

In addition to a reduction in the dollar amount of lending, researchers have also demonstrated a change in the terms of lending, commonly described as "bank effects" in borrowers' cost of funds. Lown and Peristiani (1996) examine U.S. bank lending rates in the early 1990s, and finds that under-capitalized banks charge higher than average loan rates relative to their peers on otherwise identical loans. Using a matched sample similar to the one created in this paper, Hubbard et al. (2002) document that weak banks tend to charge higher spreads on commercial loans after controlling for firm and loan specific risk factors. Along a different dimension, Murfin (2009) finds that banks experiencing large defaults in their loan portfolios write tighter loan contracts with stricter covenants in subsequent loans to their existing customers.

The results of these papers also strongly suggest that *individual* banks hold high degree of bargaining power over their existing clients, at least in the short-term. This idea, proposed in theory by Sharpe (1990), Rajan (1992), and Petersen and Rajan (1995), and demonstrated empirically by studies such as Cosimano and McDonald (1998) and Santos and Winton (2008), implies that the cost of debt for bank-dependent firms can become significantly higher even if they are able to secure the same dollar amount of debt. This fact is central to the main findings of this paper, as I seek to identify the investment impact using only bank-borrower specific variation, holding common macroeconomic conditions fixed.

1.3.3 Nonperforming Loans and Bank Lending

Before testing the net effect of bank health on firm investment, I first need to determine whether these bank health indicators cause banks to tighten lending for the banks in my sample during the period in question. Specifically, I wish to test whether changes in the capitalization and nonperforming loan ratio affect the net amount of new lending made in the subsequent year. To test this, I regress the 1-year log change in commercial and industrial loans of each matched bank against the capitalization ratio, the total non-performing loan ratio and a group of control variables.

The specification also contains bank and year fixed effects. The quarterly observations represent all 149 of the banks in the matched sample for the period from March 1986 to December 2008. For robustness, I also reduce the sample to contain just the set of bank observations for which I also have a matching borrowing firm-year observation in the full bank-borrower sample. Since I am identifying the change in bank lending behavior directly from bank variables, I do not have the additional identification that I obtain in later tests on the matched sample. As a result, these results should be interpreted with caution. However, consistent results from this test will at least confirm the relationship between lending and the non-performing loan ratio over the sample period.

The results, presented in Table 1.2, confirm the relationship between bank lending behavior and the fraction of non-performing loans at the beginning of the year. Column (1) reports the results for all sample banks from 1986 to 2009 during all years of operation. The coefficient on the nonperforming loan ratio is negative and significant, indicating that an increase in the fraction of nonperforming loans is associated with a subsequent decrease in net lending over the next year. The significant negative coefficient on assets is possibly attributable to large changes in size due to merger activity, which are not properly accounted for in the base lending estimate. Column (2) excludes all periods in which the bank acquired another bank, which may have substantially changed its lending base. Reassuringly, the coefficient on assets becomes indistinguishable from zero in this specification, and the effect of nonperforming loans modestly increases in magnitude. The results in Column (3) restricts the sample solely to the periods for which I have a matching firm-bank relationship. The coefficient on nonperforming loans remains negative and significant over this smaller sample, and the results are generally consistent with bank behavior across the entire sample. However, the capitalization ratio is insignificant in the full sample and actually marginally negative when I restrict the sample to bank observations which I can match to an active borrower. This is somewhat surprising and likely due to the across bank heterogeneity in regulatory requirements throughout the sample period.

Since this analysis examines a 20 year panel, changes in U.S. regulatory capital requirements make it difficult to measure overall health from reported capital requirements. These requirements have changed radically during this period and have been imposed unequally for different classes and sizes of banks. For estimates around a particular financial shock, within a short time horizon where regulatory requirements do not significantly change over the period or across banks, changes in a single measure of capital adequacy can provide means for reasonable inference.

Over the course of my sample the calculation and required level of regulatory capital ratios have changed significantly across different U.S. banks. For instance, certain large, money center banks have periodically had their required ratios reduced in the last 8 years, which would make cross-sectional comparison through time invalid for both large and small banks. Similarly, changes in risk weighting and the accounting for treasury holdings in the early 1990s temporarily allowed more liquid banks to manipulate their risk-adjusted capital ratios upward.[3]

The information contained in nonperforming loan ratios is less ambiguous. Nonperforming loans result from the bank's existing business, and an increase in this ratio always moves a bank closer to its existing capital limits. There is also much less discretion in reporting or transactional manipulation than in other measures of bank performance. For these reasons, nonperforming loans are often the most significant determinant of bank failure and net bank lending in existing studies. This is reinforced in a recent paper by Huang (2009), which finds a strong correlation between nonperforming loan ratios and the recall of revolving credit lines during the current financial crisis.[4]

One important benefit of being able to use the nonperforming loan ratio is that this bank level measure responds only to defaults and non-payments by its existing borrowers. In forming the sample, I remove all firms who are reported

[3]Tests of the specified regressions do not significantly load on any of the commonly used capital adequacy ratios imposed subsequent to Basel I, Basel II, and the FDICA, many of which are not available in the earlier part of the sample. The inclusion of these ratios does not materially change the results of the test.

[4]See also Peek and Rosengren (2000), Paravisini (2008), Wheelock and Wilson (2000), Campello (2002), Ashcraft (2005), Lown and Peristiani (1996), and Hubbard et al. (2002), among others.

either as “in default” by S&P or self reported as non-current on their existing debt payments. In the unlikely event that a large portion of the outstanding loan to each firm is declared to be non-accruing without being disclosed by the firm, this should still have little direct impact on the bank level measure of nonperforming loans since each individual firm makes up only a small portion of the banks total loan portfolio. In an unreported test, I also verify this question directly by separating out the commercial loan nonaccruals from other loans, and I find similar results. This helps directly address the reverse causality problem inherent in many studies of this type.

1.3.4 Bank lending and Firm Debt

Having verified that my measure of bank health is related to the lending activities of the banks in my sample, I now examine whether this shift in lending behavior also affects the borrowing behavior of the matched firms. For this test, I turn to the matched sample described in section 1.2.2. In this model, I employ separate fixed effects for each firm-bank pair, and year fixed-effects. The model identifies differences in net debt issuances as a function of changes in the health of the matched bank in the preceding period. The model is as follows.

$$\Delta Debt_{i,t} = \alpha + \beta_1 Nonperforming_{j,t-1} + \beta_2 X_{i,t-1} + C_{(i,j)} + T_t + \epsilon_{(i,j),t}$$

Change in debt, for Firm i, is measured either as the difference, scaled by assets, in Period t debt from Period t-1 debt or as the difference in *log* debt over the same period. $Nonperforming$ represents the nonperforming loan ratio of Firm i's Primary Lender j at the beginning of each period, and $X_{i,t-1}$ represents a vector of additional lagged firm-specific control variables. $C_{(i,j)}$ represents firm-bank fixed effects for each firm-bank pair (i, j), and T_t represents individual year fixed-effects. The results are presented in Table 1.3.

Columns 1 and 2 estimate the model with net debt scaled by assets. The coefficient on $Nonperforming$ is negative and significant, implying that an increase in the nonperforming loan ratio of the identified primary bank, holding macroeconomic conditions fixed, leads to a decrease in net debt issuance over the subsequent period. Specifically, an increase in the nonperforming loan ratio of from 1 to 2% is associated with a net debt issuance that is 1 to 1.15% of assets lower. Results are similar when expressed as a change in log debt. The mean change in any given year is around 5%, so the results, while not large in absolute terms, do at least suggest a meaningful average effect.

They also help confirm that the matching process produces meaningful results. Within the specified time period, relative differences in bank health, specific to Bank j, are related to the borrowing behavior of the matching Firm i. I further address the identification of this effect in the following section.

1.4 Bank Health and Firm Investment

1.4.1 Main Results

Having established the relationship between bank health and borrowing activity within my sample, I now wish to estimate whether there is any direct impact on firm investment. While relative bank health has been shown to have an impact on borrowing behavior and lending terms to firms in the U.S., there has been little direct evidence to suggest that it influences firm investment. Establishing whether or not this is true is especially important for U.S. firms, who are assumed to be less bank oriented than firms in other countries such as Japan, and presumably have greater access to alternative forms of financing.

My first test examines the impact of the main bank's nonperforming loan ratio on the annual investment level of the firm, holding all economy wide macroeconomic variation fixed. The model specification is as follows:

$$\begin{aligned} Investment_{i,t} = \alpha + \beta_1 Nonperforming_{j,t-1} + \\ \beta_2 TobinsQ_{i,t-1} + \beta_3 CashFlow_{i,t} + \\ \beta_4 X_{i,t-1} + C_{(i,j)} + T_t + \epsilon_{(i,j),t} \end{aligned}$$

$Investment$ is firm capital expenditures divided by lagged PPE. $TobinsQ$ is the market value of equity plus the book value of debt minus deferred taxes divided by book value of assets. $CashFlow$ is the net income before extraordinary items plus depreciation and amortization divided by lagged PPE. $Nonperforming$ is the ratio of nonperforming loans (loans not accruing plus loans 90+ days late) to total loans of the primary lender. $X_{i,t-1}$ represents a vector of additional lagged control variables. $C_{(i,j)}$ and T_t represent firm-bank and year effects, respectively. In all specifications, $TobinsQ$ and $CashFlow$ are treated as control variables. I treat the relationship between cash flow and investment as part of the statistical model, but I place no causal interpretation on the relationship as indicative of financing constraints. Identification of the effect is determined by the coefficient on $Nonperforming$. The inclusion of firm-bank fixed effects identifies the effect of relative changes in the $Nonperforming$ on the variation in firm investment.

The year fixed-effects in this specification are particularly important to the interpretation of the model. By controlling for time, I am isolating the variation in $Nonperforming$ that is due to the difference in bank performance within each year. Results from the model therefore capture the effect of changes in bank health *relative* to overall bank health, keeping fixed the health of other institutions. This both controls for macroeconomic trends and serves to identify the *lender specific* impact of bank distress suggested by the theory.

Results are presented in Table 1.4. Column (1) contains the coefficient estimates for the baseline model. Controlling for both firm-bank and year effects, a one standard deviation increase in the nonperforming loan ratio of 2% decreases the average investment by around the same proportion, or 10% of average investment. For comparison, the total nonperforming loan ratio across all U.S. banks increased from 1.63% in September of 2008 to 3.75% in 2009. This represents a 2.12% increase for the average bank in this period. During the same period, the nonperforming loan ratio of Citibank, the largest U.S. commercial bank, increased by nearly twice as much.

These results can be qualitatively compared to the results generated by Gibson (1995). He finds that firm investment is 30% lower for firms with the weakest banks (the worst credit rating) relative to firms with the highest rated banks, with the highest rated banks constituting roughly half of the firm observations. A direct comparison is somewhat difficult, as the firms in his sample tended to have lower growth opportunities and with an average investment of around half that in my sample. As such, a given percentage drop in investment may be more economically meaningful for the firms firms in his sample. However, it is worth noting that the estimated effect in my sample is similar in magnitude. While firms in Japan may be more bank reliant, bank health is still similarly important in determining firm investment in the U.S.

An important consideration is that, unlike other studies which directly examine cash flow sensitivities, my tests primarily include cash flow as a control. As such, I do not filter out periods of negative cash flows in my estimation. In any given year, between 15-20% of companies in the Compustat universe have a negative net cash flow, defined as earnings before extraordinary items plus depreciation and amortization. In my sample, 11% of the firm-year observations contain a negative cash flow.

As documented by Allayannis and Mozumdar (2004), negative cash flow realizations do not lead to systematic disinvestment by firms. The theoretical and empirical relationship between cash flow and investment is therefore different when firms experience negative versus positive cash flows. Practically speaking, the slope of the cash flow coefficient has a kink at zero, below which the coefficient is close to zero. As a consequence, the inclusion of these observations generates an average cash flow effect that is around half to one-third of what is typically reported by studies which either explicitly or implicitly screen out these observations. To deal with this, I also include an indicator variable and an interaction term for periods of negative cash flow. This allows the cash flow coefficient to change when cash flow realizations are negative. In specification (3), as a robustness check, I include only firm-year observations in which the cash flow was positive.

The interaction between cash flow and nonperforming is positive, though not quite significant, in specification (3). This provides some weak evidence that firms with more internal cash flow are less dependent on the stability of their bank. The fact that it is almost indistinguishable from zero in the full sample also suggests that this relationship does not hold when cash flows are negative. Since investment is not materially sensitive to negative cash flow realizations, it is reasonable to assume that firms in these situations face a very different investment decision and are not proportionally more bank reliant when their cash flows are "more" negative.

In specification (5), I include the contemporaneous non-performing loan ratio as a robustness check to identify whether the relationship is being driven by contemporaneous economic conditions. The non-performing loan ratio is very sticky, with a first order autocorrelation of 0.84. The interpretation of the main effect becomes somewhat more complicated in this specification, but the dominance of the lagged parameter indicates that the effect on investment is specific to the beginning of year bank condition. This gives additional evidence that the bank condition is directly affecting the behavior of the firm.

1.4.2 Additional Controls

While the year fixed effects specification holds economy wide macroeconomic constant, it does not necessarily capture time variation within the economy that may affect one particular group over another. Specifically, if there is a common economic component which is specific to groupings of firm-bank pairs, then the existing time effects would not fully control for the omitted variable. One possibility is that local economic shocks may affect both banks and firms located in a specific region. Overall bank health is often related to local economic conditions, especially in real estate markets, which may be correlated with a decrease in regional demand, and lower investment opportunities for regional firms. Another possibility is that certain banks may be over-exposed to certain industries, and factors affecting that industry would disproportionately affect the investment opportunities of the majority of their matched borrowers.

To address these concerns and help establish the validity of my identification strategy, I re-estimate the model with more stringent category specific time effects. To control for time varying regional economic conditions, I replace the year-effects with region-year effects. This specification includes a separate year dummy for each of the 9 major census divisions in which the firm's headquarters are located. The results are presented in Column (1) of Table 1.5. To address the possibility of unobserved industry effects, I implement industry-year fixed effects in a similar manner. Using 30 Fama-French industries, I include a separate effect for each industry in each year. These results are presented in Column (2). In both cases, despite a significant reduction in identifying variation, the effect remains significant. More importantly, the coefficient estimate remains nearly unchanged from the main regression.

While these classifications cannot completely account for unobserved economic specialization in lending, the industry-year controls should substantially reduce the coefficient if the effect is primarily driven by endogenous correlation. For this not to be the case, the common economic component must be almost entirely driven by unobserved differences within each region or industry at each point in time. If the null hypothesis that bank health has no direct effect on firm investment is true, removing the across country and across industry variation from the regression should significantly reduce the magnitude of the coefficient. Unreported Hausman tests of the single coefficient model also fail to reject the baseline specification as inconsistent compared to the more robust specifications.

The robustness of the effect to alternative specifications also illustrates the relative independence of the matching bank's health after controlling for the fixed-effects. The addition of firm level controls and within category time effects does little to alter the point estimate of the main coefficient. This indicates that the demeaned effect is strikingly orthogonal to most firm level measures which are thought to determine investment. This allows reasonably good identification in a relatively restrictive model, even though the matching process is somewhat noisy.

1.4.3 Out of Sample Comparison

While the existing test rules out the possibility of national, regional, or industry level economic drivers, performance deterioration in the current bank may proxy for some different, unobserved deterioration in economic conditions experienced by the firm. While the effect remains very robust when controlling for endogenous changes within industry and region, it remains possible that the banks exhibit lending behaviors that expose them to similar risks that are unrelated to region or industry. If this is true, the performance of that particular bank's loan portfolio would always move with the investment behavior of the firm, regardless of whether the firm relied on the bank for capital.

To address this issue, I appeal to the following argument. If the health of a firm's bank matters directly though a financing channel, there should be an observable effect when the firm has an active borrowing relationship with the bank. Prior to initiating a borrowing relationship with the bank and after termination of the borrowing relationship, there should be no sensitivity to bank performance, as the firm is no longer reliant on that particular bank to supply new capital. Alternatively, if the relationship is driven by joint exposure to common economic factors, the relationship should persist regardless of whether the firm is currently reliant on that particular bank for capital.

To test this, I take each unique firm-bank combination within the sample and create a separate time-series for each pair. Each firm-bank pair contains the observations from the sample, all available observations prior to the first loan made from the bank to the firm, and all available observations subsequent to the expiration of the last loan made. For the new panel, I create indicator variables that take on a value of 1 for periods prior to, during, and after the active firm-bank relationship window. I then include one or more interaction variables which interact the status of the banking relationship with the nonperforming loan ratio.

The specification is as follows:

$$Inv_{i,t} = \alpha + \beta_1 Nonperforming_{j,t-1} + \beta_2 X_{i,t} +$$
$$\beta_3 I_{active}[0,1]_{i,j,t} + \beta_4 I * Nonperforming_{j,t-1} + C_{i,j} + T_t + \epsilon_{i,j,t}$$

So long as banks and firms don't radically alter their exposure to external economic factors when they initiate or sever a relationship, a bank specific effect should be significant only when the relationship is active. In the context of the model β_4 should be significantly less than zero while β_1 should be close to zero. Alternatively, a common economic shock should generate a negative relationship in all periods, producing a β_1 similar to the previous specification and no loading on β_4. While the decision to switch banks is not exogenous, I argue that a quite radical shift in economic exposure is necessary during each firm's switching event for the relationship to not continue to hold in some form. The results, presented in Table 1.6, should therefore provide a reasonable test of whether the effect is specific to the firm-bank relationship.

Column (1) estimates the main regression on the panel in the pre and post relationship periods, *excluding* the main sample period. Consistent with the idea that the effect is solely a function of the existence of a lending relationship, the coefficient on nonperforming loans is not significantly different from zero. Column (2) estimates the baseline effect for the entire sample, with an additional interaction term taking on a positive value during the active sample period. This interaction model gives an estimate of the additional effect that presents itself when there is a banking relationship. The coefficient is negative and significant, while the baseline coefficient remains indistinguishable from zero. The model in column (3) jointly estimates a separate effect in each period, before, during, and after a lending relationship is in place. In all time periods where there is no lending relationship, the coefficient is indistinguishable from zero.

One particular concern in this analysis is that the estimation of the termination of a banking relationship is quite noisy. The primary problem I face is that, since Dealscan does not contain the entire universe of loans made to these companies, I cannot determine completely whether the borrower is maintaining an active borrowing relationship and the loans were simply not recorded by LPC. Secondly, where I record a post relationship period, it may be the case that the bank continues to have a relationship with the firm but it has simply been displaced as the main lender. There is no clear way to distinguish between a true cessation of the relationship and simply not being able to observe a new loan. However, both of these sample errors should bias the tests against this finding.

1.4.4 Matching and Sources of Bank Distress

One further question which should be addressed is one of time varying selection. As described in the previous section, the consistency of these estimates depends on the conjecture that the factors which influence firm-bank matching are fixed for the period in which I examine. One might worry, for instance, that banks are radically changing their economic exposure to types of commercial loans over time. If banks are not reasonably well diversified, we may worry that banks rotate over time between making large numbers of bad commercial investments and then recovering and making better ones.

Throughout this paper, I have argued that these effects are primarily fixed in time, and that the evolution of bank distress is largely unforeseen and unrelated to the bank's commercial lending operation. The primary driver of portfolio non-performance, especially the non-systematic component, is defaults in the non-commercial lending arm of the bank. In particular, bank distress is heavily disproportionally driven by failures in real estate lending. Since the commercial and non-commercial lending divisions of major banks are quite separate in their operation, it is unlikely that predictable, poor investment selection in non-commercial lending is correlated with identical ex-ante shifts in exposure by the commercial and industrial lending division.

At the bank level, I am able to break out nonperformance by categories. Specifically, I can separate the portion of the non-performing loan ratio which is due to Commercial and Industrial (C&I) loans and the portion due to non-C&I loans. Using this separation, I run two separate regressions, examining the separate impact of shocks to the NPL Ratio of the C&I loan portfolio and the NPL Ratio of the non-C&I loan portfolio. The results are presented in Table 1.7. Model (1) reports the total NPL of the firm's main bank along with the separate impact of the C&I portfolio. Model (2) reports the separate effect of the C&I and non -C&I components.[5]

[5] Since the nonperforming loan ratio of the total portfolio is a linear combination of the NPL of the C&I and Non-C&I portfolio, both regressions are functionally actually identical estimations. They are presented separately for the purpose of interpretation.

As can be seen from the insignificant coefficient in Model (1), defaults in the C&I portfolio do not contribute any *additional* impact to the investment of the borrower. As illustrated in Model (2), the point impact of defaults is roughly the same magnitude, but the statistical power is primarily concentrated among the non C&I portfolio. This confirms the conjecture that the impact on firm investment is being driven by unanticipated shocks to bank health as a whole, rather than time-varying selection of underperforming commercial loan clients. Moreover, it suggests that there is no additional informational component in the innovations to bank-nonperformance. Declines in the performance of the bank's C&I portfolio do not disproportionately impact the investment of their commercial borrowers, so it is unlikely that the transmission of shocks is due to information based re-evaluation of the bank's C&I lending policies.

1.4.5 Bank Location and Distance

The physical location of the bank, the location of the firm, and the distance between them provide a useful testing ground for the determinants of bank dependence. In addition to providing robustness checks for correlated economic conditions, the distance between the headquarters of the firm and the headquarters of the bank should be related to the relative importance of bank health and bank financing.

As illustrated in Figure 1.2, there is wide variation in location across the sample for both borrowers and lenders. In addition to being geographically diverse themselves, there is also wide variation in the distance between the bank and the firm. Borrowers may do business with banks located anywhere from a few miles to over 5000 miles away. The median estimated distance between borrower and lender in the sample is 500 miles, and over three-fourths of the firms in the sample have a borrowing relationship with a bank headquartered in a different state.

Firms borrowing from local banks face similar regional economic conditions. Those banks are likely to have retail customers whose deposits and purchasing behavior are correlated with the local economy. They are also likely to cater to commercial customers in similar industries and with similar customer bases. Firms borrowing from non-local banks do not face these same issues, but they may face greater difficulty when trying to negotiate new loans.

When banks contract their credit supply, they are likely to do so to those customers who are more difficult to monitor. Therefore, if the link between investment and bank health is related to credit availability, we would expect to see the relationship become more negative with greater distances between the firm and the bank.

To test this question, I split the sample into two groups based upon the geographic location of the firm relative to the bank. I gather the city, state, and zip code of each firm headquarters from Compustat and each bank headquarters from their Call Reports. I first divide the sample into firms borrowing from banks located within the same state and firms which borrow from banks in a different state. Second, I divide across firms borrowing from banks within and across the 9 U.S. census divisions. Lastly, I create a physical distance measure by calculating the number of miles between the zip code of the firm and bank. The median distance between firm and bank is roughly 500 miles, so I split the sample between firms who are more than 500 miles away from their bank and those firms who are less than 500 miles away from their bank.

Ideally, I would like to isolate the operating area of each firm and not just the location of the main headquarters. The location of the headquarters is an inexact measure of the geographic reach of the firm and the bank. However, even for firms with a national reach, the location of the firm headquarters still represents the firm's strongest administrative presence.

The results of this specification are presented in Table 1.8. Bank sensitivity does not vary significantly between firms using local banks and firms using non-local banks. In fact, the magnitude of the effect is slightly higher for firms located across state and regional boundaries. This implies that the measured effect is not being generated by regional correlation in economic conditions.

The coefficient is actually significantly larger at the 10% level for firms located more than 500 miles away. This suggests that greater distance may make firms more likely to cut investment. It also suggests that these firms may face greater informational frictions in their borrowing.

Since firms should optimally weigh the information costs of greater distance when choosing their lender, a univariate increase in distance does not necessarily imply greater information costs. However, it is reasonable to assume that firms who are located closer to their lenders do have an informational advantage during times of distress. Additionally, firms who borrow from more distant lenders may be unable to borrow locally because there is not enough local banking capital satisfy their needs.

This would also make them more dependent on their existing bank.

1.5 The Determinants of Investment-Bank Health Sensitivity

1.5.1 Cross-Sectional Characteristics

Having established the average investment response to lender health, I now turn to the question of the cross-sectional determinants of this effect. The importance of bank financing varies considerably from firm to firm. Theory implies that the importance of bank capital to a firm is heavily dependent on the degree of asymmetric information, the relative importance of agency considerations, and by extension, the firm's inability to raise external financing from arm's-length transactions. Given this, the impact of bank health should covary with empirical proxies for these determinants.

The reliance on bank capital can be thought of as a specific type of financial constraint that only binds in certain states of the world. It is generally thought that strong banking relationships smooth financial frictions and make firms less reliant on internal cash flows[6]. Firms that rely heavily on bank borrowing make a tradeoff between this benefit and the hold-up costs generated in states of the world where the firm needs to obtain outside financing. The firms most affected by lender health are those which have less access to other forms of financing and those for which asymmetric information make it more difficult to secure new sources of financing.

To test this, I split the sample into groups based on four classification schemes,

[6]See Hoshi et al. (1991)

which serve as proxies for these frictions. For each classification, I rank the firms based on their status as of the year the relationship was initiated so that the time-series for each firm is contained within a single group. First, I split the sample into three groups based on the debt rating of the firm at the time the firm-bank relationship was initiated. The three groups represent firms with a debt rating of BBB- or better, firms with a debt rating of BB+ or worse, and firms without a debt rating. Second, I split the sample into groups based on the top and bottom third of the sample based on firm age, asset tangibility, and the ratio of bank debt to property, plant and equipment. Firm age is defined as the number of years the firm has reported in Compustat up to that point, and asset tangibility is the ratio of net property, plant, and equipment to total assets.

Firm age and asset tangibility proxy for the relative transparency of the firm, with older firms and firms with more tangible assets having a greater degree of transparency. The ratio of bank debt to PPE indicates the overall reliance on bank capital and also proxies for the available collateral of each firm.[7]

The results are presented in Table 1.9. Firms with a bond rating of BBB- or better are considered to have investment grade debt. Bond ratings below BBB- are considered to below investment grade, or junk. As expected, firms with investment grade debt do not show a marked sensitivity to their bank's health as compared to unrated firms. Surprisingly, the bank coefficient for the junk rated firms is 2.5 times as large as the average coefficient for the full sample. This suggests that, while these

[7]Chava and Purnanandam (2010), for instance, employ the same measure as a proxy for available collateral.

firms may have access to public debt markets, they are also heavily bank dependent.

These results parallel the findings of Rauh and Sufi (2009), who show that low credit quality firms are more likely to have a tiered capital structure that includes covenant heavy bank debt and "rely on tightly monitored secured bank debt for liquidity." They find evidence that firms with low credit quality lose access to arm's-length short term program debt, such as commercial paper, and are forced to rely on secured bank debt for liquidity. These firms are therefore more likely to have their short term investment influenced by bank decisions, since they are the firms over which banks exert the most control.

The effect is much stronger for firms with low asset tangibility and a large bank debt ratio, suggesting that more opaque firms and firms with less available collateral face greater problems when their current bank is in trouble. As expected, older firms appear to be slightly less sensitive to bank debt, though the difference is not statistically significant.

1.5.2 Investment-Bank Sensitivity Over Time

Prior to the financial crisis of 2007-2008, many researchers had suggested that bank relationships were becoming much less important in corporate finance. The prominence of "transaction oriented" banking and the rapid consolidation of banks in the last decade changed how banking relationships were perceived. Ashcraft (2005), for instance, begins his study on the effects of two bank failures in the late 80s by questioning whether, given the existence of deposit insurance and the reduction in bank dependency of the US economy, bank failures actually still matter.

In light of recent events, this conjecture demands further investigation. To address this, I include two time trend variables in the model. First, I include a simple time variable, taking on a value of “1” in 1987 and increasing by 1 each year, interacted with the nonperforming loan ratio. Second, I divide the sample into seven three year time periods and separately estimate the impact of nonperforming loans for each period. The results are presented in Table 1.10.

Under the assumption that bank dependence has been steadily decreasing over time, the interaction of the time trend with the nonperforming loan ratio gives a linear estimate of the change over time. Under this very restrictive assumption, the effect would have diminished to around zero by the year 2000. The period estimation suggests that the effect was measurably significant between 1988 and 1996 and became completely insignificant until the most recent period. Given that the early 1990s represent the last major period of widespread bank distress in the U.S., it is unsurprising that the effect should be most concentrated then since most of the independent sample variation is concentrated there. Consistent with conjectures about the diminished importance of banking relationships, the effect appears to have diminished after then. However, I cannot verify whether this is true since the lack of variation during this period drastically reduces the power of the test.

The point estimate for the most recent period is quite large, even larger than that of the estimated effect in the early 1990s. The standard error is also quite large, so the estimate can only be considered marginally significant. However, combined with recent evidence on the same effect found by studies such as Huang (2009), it does point to a widespread increase in the importance of bank health. This and other studies provide an increasing body of evidence that the stability of banking relationships remains a vital part of efficient corporate investment.

1.6 Conclusion

In this paper, I provide evidence of the impact of bank health on the investment expenditure of their existing borrowers. I find that firms with established borrowing relationships show a significant decline in investment when the nonperforming loan ratio of their primary bank increases. This relationship is specific to the firm-bank relationship, and is not driven by unobserved changes in regional or industry-specific factors. These effects represent a capital constraint over and above the macroeconomic effects of overall credit tightening, and provide new insight into the tradeoffs inherent in bank financing.

The effect is strongest amongst firms that are more informationally opaque, have fewer tangible assets, and have less access to outside financing. These firms are likely to see the greatest benefits from the screening and monitoring activities provided by banks, but they are also more likely to be adversely impacted when their particular bank runs into problems. This is especially important in light of recent events, where the largest banks in the United States have become seriously distressed. These banks were once viewed as being among the most stable institutions in the financial industry, having a reach that far exceeds the major distressed banks of the 1990s.

The largest concern facing policy makers is whether these large-scale failures in the financial sector have led to a debilitating shortage of credit across the board, and what range of policies will be most effective in spurring new lending. However, the reliance of firms on existing banking relationships makes it more difficult for firms to find new sources of capital. This raises the additional concern that access to financing will constrain new investment in a substantive way, blunting the growth of an entire class of firms.

The findings of this paper suggest that the impact on firm investment is reasonably substantive. This has important policy implications for both regulators and bank dependent firms. It also raises new questions about how banks determine their lending policy to both existing and new clients. The internal workings of bank lending policy, especially when faced with financial constraints, are still somewhat of a mystery. On the firm side, it raises questions about how firms form new lending relationships, especially when the costs of switching are significant. Future research in this area will certainly provide an important window into banks and the fundamental importance of informed capital.

Figure 1.1: Sample Construction Illustration

The following figure illustrates the sample construction process. Each point on the timeline represents the end of the indicated year. In this example, Dealscan records two loans taken out by Compustat Firm 1. The first loan establishes the main firm-bank relationship between Firm 1 and Bank A, beginning as of the end of 1990. During 1992, a second loan is taken out, funded primarily by Bank B. As of 1992, Bank B now provides the majority of all bank capital to Firm 1. Since Loan 2 expires after the first loan, Bank B permanently supplants Bank A as the firm's primary lender in 1992.

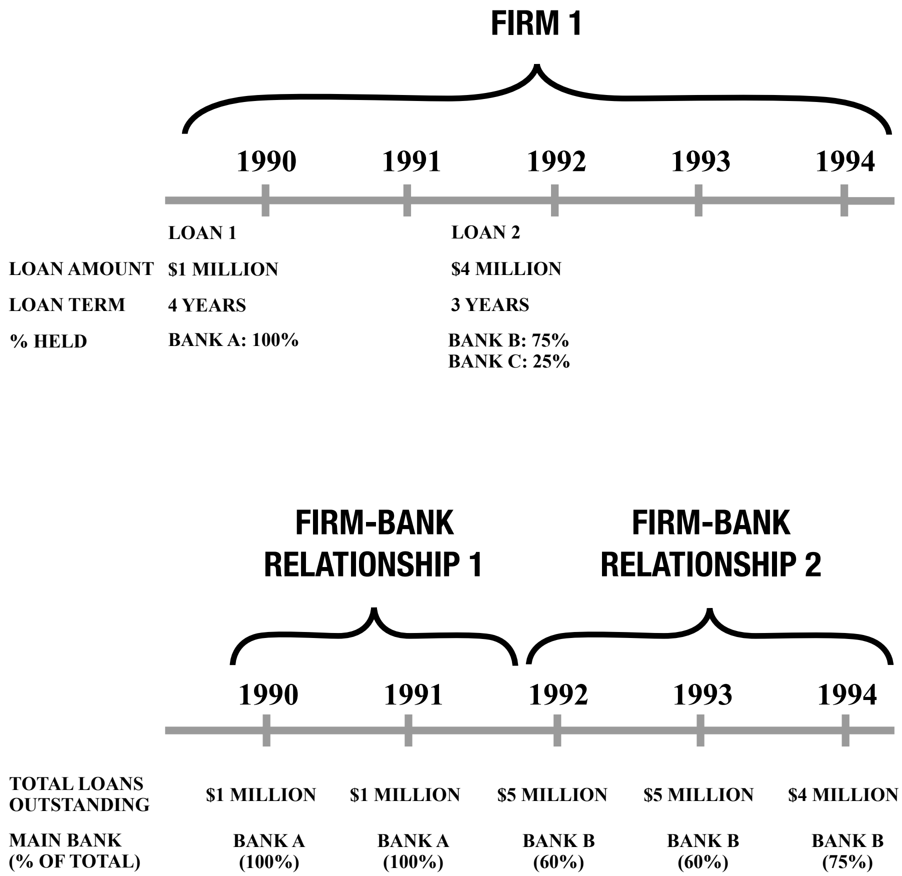
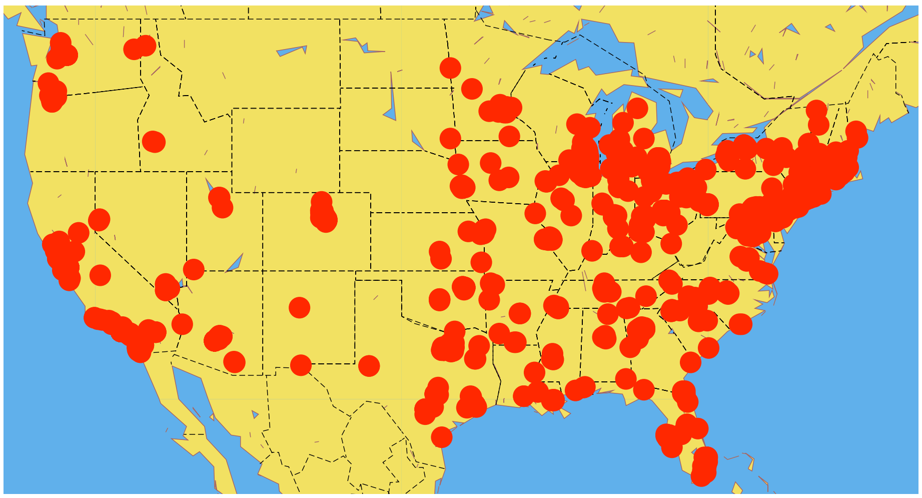


Figure 1.2: Geographic Location of Firms and Banks

The following two maps show the geographic location of the headquarters of each firm and bank in the sample for which a zip code is available in the continental United States. Each dot represents the location of one or more entities, placed by zip code, as recorded by either the Compustat tapes or Call Report data.

(a) Firm Locations



(b) Bank Locations

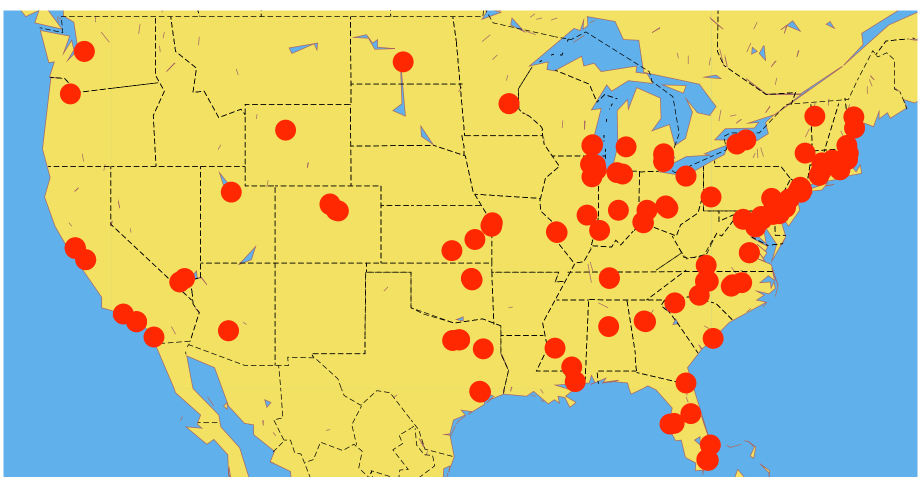


Table 1.1: Summary Statistics

This table presents summary statistics for the main sample. The sample contains all firm-year observations, from 1987 to 2008, for which I was able to successfully match the firm's largest or second largest lender to a commercial bank in the Call Reports. The sample was created by aggregating all loans recorded by LPC in the Dealscan database and estimating the largest loan holder for each firm in each year. Where I was unable to match the largest lender, I matched the second. I exclude the year in which the lending relationship is initiated and any observations where the estimated outstanding loan amount exceeds the total debt recorded in Compustat or where the bank's debt share exceeds the capital of the matched bank. The sample contains 1370 unique firms and 140 unique banks.

	Mean	SD	10th	25th	Median	75th	90th
Investment	0.240	0.221	0.070	0.116	0.185	0.280	0.446
Nonperforming	0.021	0.022	0.004	0.008	0.013	0.023	0.053
Tobins-Q	1.603	0.907	0.921	1.056	1.324	1.796	2.601
CashFlow	0.308	0.892	-0.064	0.124	0.260	0.475	0.869
Loan/Assets	0.196	0.174	0.038	0.082	0.156	0.263	0.392
Z-Score	1.671	1.311	0.400	1.067	1.725	2.389	3.072
Firm Assets	5,820	14,724	55	236	1,209	4,651	15,377
Bank Assets	320,649	370,832	9,173	34,737	147,120	562,116	967,365
Observations	4388						

Table 1.2: Bank Health and Commercial Lending

This table presents regression results for commercial lending model. The model is estimated using quarterly Call Report data. The dependent variable is the annual *log* change in Commercial and Industrial loans of the bank. Capitalization is the ratio of total equity to assets. Nonperforming is the ratio of nonperforming loans to total loans. Income is the 1-year net income of the bank divided by the beginning of period assets. Deposits/Assets is the total amount of ordinary deposits for each bank. Each model also contains bank and year fixed effects. Model 1 estimates the results for all matching banks in all available years between 1986 and 2009. Model 2 excludes all periods in which a particular bank underwent a major merger. Model 3 contains only bank-year observations for which I also have a matching borrower relationship and matching firm data in CRSP-Compustat. All estimates are Huber-White corrected for heteroskedasticity and clustered at the bank level.

	(1)	(2)	(3)
Capitalization$_{t-1}$	1.354	0.0756	-0.754*
	(1.078)	(0.288)	(0.419)
Log(Assets)$_{t-1}$	-0.130***	-0.00107	-0.0270
	(0.037)	(0.014)	(0.017)
Nonperforming$_{t-1}$	-2.594***	-3.144***	-1.883***
	(0.581)	(0.335)	(0.508)
Income$_{t-1}$	0.0363***	0.00803	2.265
	(0.014)	(0.012)	(1.460)
Deposits/Assets$t-1$	0.0990	-0.0734	-0.128
	(0.268)	(0.096)	(0.101)
N	3482	3241	1057
R^2	0.096	0.132	0.323
Bank Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.3: Bank Health and Net Borrowing

This table presents the results of the net borrowing regressions for the full panel. Net borrowing is defined either as current period outstanding debt minus the previous year divided by total assets or as the difference in *log* debt over the same period. All regressors, with the exception of Cash Flow, are lagged one year unless otherwise noted. Nonperforming is the ratio of nonperforming loans divided by the total outstanding loans. Tangibility is the ratio of net PPE to assets. Cash Flow is defined as earnings before extraordinary items plus depreciation over the same period divided by total assets at the start of the period. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	ΔDebt/Assets		Δlog(Debt)	
	(1)	(2)	(3)	(4)
Nonperforming	-0.963***	-1.155***	-2.433***	-2.805***
	(0.339)	(0.332)	(0.909)	(0.920)
Tangibility		-0.322		-0.376
		(0.262)		(0.249)
Log(Sales)		-0.0644***		-0.167***
		(0.016)		(0.046)
Market-to-Book		0.0623***		0.193***
		(0.011)		(0.039)
Cash Flow		-0.00644		-0.0541
		(0.019)		(0.035)
N	4356	4196	4342	4183
R^2	0.547	0.588	0.552	0.593
Firm-Bank Fixed Effects	Y	Y	Y	Y
Year Efects	Y	Y	Y	Y

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.4: Bank Health and Investment

This table presents the results of the investment regressions for the full panel. The dependent variable is defined as capital expenditures divided by beginning of period PPE. All regressors, with the exception of Cash Flow, are lagged one year unless otherwise noted. All models include an unreported negative cash flow indicator. Nonperforming is the ratio of nonperforming loans divided by the total outstanding loans. Tobins-Q is defined as the market value of assets divided by the book value of assets, where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes. Cash Flow is defined as earnings before extraordinary items plus depreciation, divided by PPE. Rated indicates the presence of a debt rating, while Junk indicates the subset of those ratings which are BB+ or below. Z-Score is the sum of 3.3 times pre-tax income, sales, 1.4 times retained earnings, and 1.2 times net working capital all divided by total assets. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	(1)	(2)	(3)	(4)	(5)
$\text{Nonperforming}_{t-1}$	-0.999***	-1.042***	-1.247***	-0.922***	-0.727**
	(0.287)	(0.301)	(0.454)	(0.295)	(0.305)
Tobins-Q	0.0532***	0.0534***	0.0504***	0.0405***	0.0406***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
CashFlow	0.107***	0.103***	0.105***	0.105***	0.105***
	(0.022)	(0.022)	(0.028)	(0.023)	(0.023)
CashFlow * $I_{CF<0}$	-0.161***	-0.164***		-0.150***	-0.151***
	(0.033)	(0.034)		(0.034)	(0.035)
CF * Nonperforming		0.305	1.674		
		(0.468)	(1.084)		
Z-Score				0.0558***	0.0557***
				(0.008)	(0.008)
Log(Assets)				-0.0501***	-0.0496***
				(0.017)	(0.017)
Rated				0.0257	0.0247
				(0.017)	(0.017)
Junk				-0.0226*	-0.0226*
				(0.013)	(0.013)
Nonperforming_{t}					-0.509
					(0.394)
N	4120	4120	3622	3847	3847
R^2	0.776	0.776	0.793	0.785	0.785
Firm-Bank Fixed Effects	Y	Y	Y	Y	Y
Year Effects	Y	Y	Y	Y	Y

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.5: Bank Health and Investment: Robustness Check

This table presents the results of the investment regressions with additional category-time effects as controls. The dependent variable is defined as capital expenditures divided by beginning of period PPE. Region-Year effects represent a separate dummy variable for every unique combination of the year and the U.S. Census Division in which the firm is headquartered from years 1987 to 2008. Firm headquarters locations are taken from Compustat. Industry-Year effects contain a separate dummy variable for every unique year-industry combination from years 1987 to 2008 and 30 Fama-French industry classifications. Each model also includes an unreported negative cash flow indicator. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	(1)	(2)
Nonperforming	-0.943***	-1.074***
	(0.288)	(0.293)
Tobins-Q	0.0549***	0.0469***
	(0.011)	(0.010)
CashFlow	0.103***	0.104***
	(0.021)	(0.023)
CashFlow * $I_{CF<0}$	-0.153***	-0.161***
	(0.032)	(0.033)
N	3923	4120
R^2	0.794	0.818
FixedEffects	Firm-Bank	Firm-Bank
TimeEffects	Region-Year	Industry-Year

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.6: Investment Regressions Across Changes in Banking Relationship Status

This table presents the results of the fixed effects regression of bank health on firm investment, from 1985 to 2008, including periods extending six years prior to the initiation of the banking relationship and six years subsequent to the expiration of the relationship. Each firm-bank pair is extended to all time periods during which the firm and bank have recorded information in both data sets. Pre-relationship period represents all firm-bank-year observations prior to the first recorded loan between the firm and bank. Post-relationship period represents all firm-bank-year observations after the bank was supplanted as the firm's main lender. Current represents all observations within the main sample. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm level.

	(1)	(2)	(3)
Nonperforming	-0.175	-0.174	
	(0.216)	(0.217)	
Nonperforming * Current		-0.915**	-1.099***
		(0.380)	(0.315)
Nonperforming * Post			-0.281
			(0.192)
Nonperforming * Pre			0.210
			(0.375)
N	7873	11357	11357
R^2	0.556	0.607	0.669
Firm-Bank Fixed Effects	Y	Y	Y
Year Effects	Y	Y	Y

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.7: Impact of Different Sources of Bank Non-Performance

This table presents the results of the investment regressions with the inclusion of a separate regressor for the Commercial and Industrial loan component of the non-performing loan ratio. The dependent variable is defined as capital expenditures divided by beginning of period PPE. Model (1) includes the total NPL ratio and the ratio of commercial and industrial (C&I) nonperforming loans divided by total C&I loans. Model (2) replaces the NPL ratio of all loans with the NPL ratio of non-C&I loans. Note that, since the nonperforming loan ratio of the total portfolio is a linear combination of the NPL of the C&I and Non-C&I portfolio, both regressions are functionally actually identical estimations. They are presented separately for the purpose of interpretation. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	(1)	(2)
$\text{Nonperforming}_{t-1}$	-1.106**	
	(0.503)	
NPL Ratio (C&I Loans)	0.299	-0.806
	(0.906)	(0.545)
NPL Ratio (Non-Commercial)		-1.106**
		(0.503)
Tobins-Q	0.0559***	0.0559***
	(0.012)	(0.012)
Cash Flow	0.111***	0.111***
	(0.023)	(0.023)
N	4047	4047
R^2	0.784	0.784
Firm-Bank Fixed Effects	Y	Y
Year Effects	Y	Y

Table 1.8: Bank Effects and Geographic Distance

This table presents the investment regressions split across three distance measures. For each firm-bank combination, I estimate whether the matched bank and firm headquarters are located in the same state or region or are located in differing states or regions. The distance is calculated as number of miles between the zip code of the firm, as recorded by Compustat, and the zip code of the bank as recorded by Call Report item rssd9220. The p(difference) statistic reports the Chi-Sqared significance level of the difference between the Nonperforming coefficients in each model under the Wald test. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	State		Region	
	Same	Different	Same	Different
Nonperforming	-0.775	-1.378***	-0.725	-1.675***
	(0.541)	(0.418)	(0.445)	(0.511)
Tobins-Q	0.0448**	0.0587***	0.0452***	0.0630***
	(0.021)	(0.014)	(0.016)	(0.016)
CashFlow	0.153***	0.0984***	0.124***	0.0966***
	(0.050)	(0.023)	(0.044)	(0.025)
p(difference)		0.380		0.158
N	956	3006	1453	2470
R^2	0.765	0.783	0.770	0.781

	Distance	
	Less than 500 Miles	More than 500 Miles
Nonperforming	-0.638*	-1.942***
	(0.377)	(0.556)
Tobins-Q	0.0485***	0.0601***
	(0.016)	(0.017)
CashFlow	0.124***	0.0927***
	(0.039)	(0.026)
p(difference)		0.0504
N	1803	2004
R^2	0.755	0.788

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 1.9: Determinants of Investment Sensitivity

This table presents the investment regressions split across ex-ante proxies for bank dependence. Each proxy is calculated at the initiation of the lending relationship, such that all yearly observations in a given firm-bank pair are assigned to only one model. Firms which had a bond rating of BBB- or greater are classified as Investment grade firms. Firms with a bond rating of BB+ or less are classified as Junk grade. Firms which had no bond rating as of the initiation of the relationship are classified as Unrated. Firm age, Asset Tangibility, and Bank Debt/PPE are divided into the top and bottom third of each category. Firm age is the number of years that the firm has appeared in Compustat. Asset Tangibility is the ratio of net property, plant, and equipment to total assets. Bank Debt/ PPE is the ratio of estimated outstanding bank debt divided by net PPE. The p(difference) statistic reports the Chi-Sqared significance level of the difference between the Nonperforming coefficients in each model under the Wald test. For the Debt Rating groups, p(difference) tests the difference of the coefficient in each model from the coefficient in the Investment model. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	Debt Rating			Firm Age	
	Investment	Junk	Unrated	Young	Old
Nonperforming	-0.0797	-2.804***	-0.848**	-1.331**	-0.754*
	(0.488)	(0.914)	(0.363)	(0.561)	(0.411)
Tobins-Q	0.0321***	0.0595**	0.0589***	0.0751***	0.0428***
	(0.010)	(0.024)	(0.018)	(0.019)	(0.011)
CashFlow	0.0944***	0.126*	0.110***	0.118***	0.0682***
	(0.029)	(0.067)	(0.031)	(0.040)	(0.009)
p(difference)		0.00746	0.203		0.402
N	1502	658	1960	1262	1648
R^2	0.754	0.851	0.761	0.804	0.765

	Asset Tangibility		Bank Debt/PPE	
	Low	High	Low	High
Nonperforming	-1.650**	-0.505	-0.0952	-1.479**
	(0.757)	(0.465)	(0.409)	(0.658)
Tobins-Q	0.0635***	0.0517***	0.0435***	0.0670***
	(0.020)	(0.015)	(0.016)	(0.023)
CashFlow	0.0860***	0.255***	0.254***	0.0787***
	(0.018)	(0.063)	(0.053)	(0.017)
p(difference)		0.0710		0.193
N	1305	1350	1360	1315
R^2	0.780	0.752	0.765	0.788

Table 1.10: Bank Effects Over Time

This table presents the investment regressions, fitted with a time trend. The time trend t, takes a value of 1 in 1987, the first year of the sample, up to 22 in 2008, the last year of the sample. Model (1) presents the full sample, while Model (2) includes only firms for which the absolute largest lender could be successfully matched. Model (3) estimates a separate effect for each of 7 subsample periods. Coefficients on Tobin's-Q and Cash Flow are estimated but not unreported. All estimates are Huber-White corrected for heteroskedasticity and clustered at the firm-bank level.

	(1)	(2)	(3)
Nonperforming	-1.700***	-2.224***	
	(0.539)	(0.751)	
t (t=1, 1987)	-0.0108***	-0.0110***	
	(0.004)	(0.004)	
t * Nonperforming	0.0973*	0.177*	
	(0.055)	(0.092)	
$\text{Nonperforming}_{1988-1990}$			-0.931
			(0.653)
$\text{Nonperforming}_{1991-1993}$			-1.357***
			(0.357)
$\text{Nonperforming}_{1994-1996}$			-1.642**
			(0.829)
$\text{Nonperforming}_{1997-1999}$			-1.275
			(1.387)
$\text{Nonperforming}_{2000-2002}$			0.716
			(1.006)
$\text{Nonperforming}_{2003-2005}$			0.282
			(0.563)
$\text{Nonperforming}_{2006-2009}$			-4.720*
			(2.523)
N	4120	3108	4120
R^2	0.776	0.757	0.776

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Chapter 2

Agency Costs, Information, and the Structure of Corporate Debt Covenants

2.1 Introduction

Since the work of Smith and Warner (1979), researchers have recognized the critical influence of debt covenants in determining and shaping the cost of financial contracting. Debt covenants play a major role in mitigating the agency problems inherent in corporate finance by providing explicit restrictions on firm actions and by providing contractual rights to ex-post intervention on the part of the financier. The existence of these covenants is seen as evidence for the importance of agency conflicts, in particular those conflicts generated by risk-shifting incentives described in Jensen and Meckling (1976). The implied cost of these contracting provisions, documented, for example, in Chava and Roberts (2008) and Roberts and Sufi (2009), is seen as evidence of the costliness of external finance. A growing body of empirical research has begun to verify these ideas by estimating the determinants of covenant assignment and by demonstrating the relationship between agency frictions and the overall strictness of debt contracts.

While a number of theoretical and empirical studies have examined the determinants of covenant strictness, few studies have examined the motivation behind the choice *between* various covenants. Firms appear to exhibit specific preferences in the selection of one covenant over another based on their characteristics and capital structure, and little research has been done to distinguish these differences. This study examines how basic agency problems create a series of tradeoffs in the selection of three different types of covenants, dividend restrictions, investment restrictions, and cash flow maintenance covenants.

We develop a model of covenant choice that highlights the tradeoff between the choice of covenants. We argue that investment covenants, which cap ongoing investment expenditure, serve to restrain firms who are likely to have significant risk shifting incentives due to low intermediate cash flows. The cost of investment restrictions is that it takes away the ability of the manager of a firm to make use of the new information about the value of investment that arrives over the life of a loan. The use of a cash flow covenant serves to mitigate this problem by transferring control to the lender only when risk-shifting is most likely to lead to inefficient investment. Conversely, a cash flow covenant allow the firm to fully control its investment decision via internally generated funds when risk shifting incentives are low, and the lenders are most likely to pursue a sub-optimal investment policy.

We show how the value of investment covenants relative to cash flow covenants changes with variation in firm quality, information quality, and informational asymmetry. The model predicts that investment covenants will be most valuable for the lowest quality firms while the use of cash flow covenants is non-monotonic in firm quality. The model further predicts that cash flow covenants will become more valuable when lenders are more symmetrically informed about the value of the firm's investments. Empirically, we find evidence to support these predictions as investment restrictions are most common for the lowest quality firms. By contrast, the occurrence cash flow covenants decreases for both the highest and lowest quality firms, and is more common among firms with higher growth opportunities. In addition, repeated banking relationships increase the likelihood of cash flow covenant use.

Our model starts with the basic premise that a firm investing in long-term projects face uncertainty about both future cash flows and the value of future investment opportunities. Information about the value of reinvestment is learned by the firm through its operation, but this information cannot be fully observed by the outside market. This information asymmetry, which develops after the initial project begins, makes it preferable to secure financing which does not have to renegotiated or rolled over prior to the reinvestment decision. Such a contract allows the firm to make its reinvestment decision with interim cash flows by not requiring full repayment until the final payout from the project. This allows the firm to make full use of its private information when it acquires it.

In this model, new information about the value of ongoing reinvestment and uncertainty about future cash flows make it difficult to efficiently contract on the optimal level of future reinvestment. As suggested by Myers (1977), dividend restrictions are often necessary to prevent the firm from paying out cash flows to shareholders when the value of reinvestment is revealed to be low and debt levels are high.[1] While

[1]The importance and relative ease of implementation is supported by the fact that dividend restrictions are very common in debt agreements. In a sample of 3,500 private credit agreements,

dividend payout restrictions provide a well defined way to prevent shareholders from directly expropriating the firm's cash, the firm still has the ability to expropriate value from the debt holders through its ongoing investment policy. When the firm faces a high probability of bankruptcy and the outcome of follow-on investment is risky, it will have an incentive over-invest its internal cash flows. What remains is a trade-off between the positive value of giving the firm discretion to use its private information about the value of new investment and the value destruction caused by the firm's incentive to over-invest. This trade-off gives rise to the selective use of two different classes of covenants: explicit restrictions on the level of future investment and maintenance covenants specifying minimum cash flow to debt ratios.

The accuracy of this information and the severity of the firm's risk-shifting incentive determines whether it is optimal to restrict total investment ex-ante through investment covenants or to create an ex-post trigger, conditional on low future cash flow realizations, which will allow the lender to dictate the investment decision. First, the contract may specify an investment restriction, which caps future investment. This can be equivalent to including an intermediate interest payment since it will reduce the cash available for future investment. However, since this provision must be specified in advance when both parties are uninformed, it also reduces the value of the firm's future private information. For this reason, it is only optimal to impose such a restriction when the risk of eventual default is high and the value of information is low.

Nini et al. (2009) find that over 80% of the loan agreements contain a dividend restriction, by far the most common covenant present.

If the lender is able to verify the firm's private information through active monitoring, it may become optimal to give the lender discretion over the firm's investment policy ex-post rather than specifying an investment restriction (or intermediate repayment) ex-ante. The lender holds a concave claim on the firm's assets and would choose to under-invest when it makes the reinvestment decision, especially if the firm is relatively safe. Because this distortion is greatest when cash flows are high, it becomes optimal to give this discretion to the lender only when cash flows are low.

Crucial to our model is the interpretation of the role of covenant violation and the transfer of control. We interpret this control transfer as a function of the threat point implied by technical default from covenant violation. If the debt is a short term facility which has come due and the firm has insufficient funds to fully repay the promised payment, the lender can credibly threaten the firm with liquidation. The threat to declare the firm insolvent is credible because a bankruptcy court cannot force a lender to make a further investment. However, when such investment funds are already committed, such a threat is no longer credible if the firm's equity is still valuable under the existing contract. Thus, the threat point is one in which the lender demands full or partial repayment under the existing contract. In this case, the lender will demand repayment so as to leave the firm with enough funds to make the lender's preferred investment.

When cash flows are high and the firm's risk-shifting incentives are low, the firm retains full access to its internal cash flows and can invest or repay according to its private information. Since the firm can invest according to its information without new financing, it cannot be held up by the lender who would choose to underinvest. This provision is only valuable when the lender is sufficiently informed, and the firm's future cash flows are not consistently high or low relative to the final debt repayment. If the cash flows are consistently high and the bankruptcy risk is always low, it is never optimal to give control to the bank. If the bankruptcy risk is always high given the cash flows, it is optimal to always give the bank control or simply restrict allowable investment ex-ante to avoid hold-up.

Empirically, we document that the use of investment restrictions is monotonically increasing in financial risk. By contrast, maintenance covenants specifying minimum cash flows as a function of debt are less common among firms with the highest and lowest levels of financial risk. We find that these cash flow covenants are more common among firms with higher growth opportunities and relatively high cash flows.

By contrast, firms are more likely to have investment restrictions when they have lower growth opportunities and declining sales. Additionally, while low industry sales growth positively predicts the inclusion of both investment restrictions and cash flow maintenance covenants, own firm sales growth does not appear to influence the inclusion of cash flow covenants, suggesting that their inclusion is influenced by the desire to shape future uncertain outcomes.

We also show that cash flow covenants are more likely to be included for firms which have borrowed from the same bank in the last five years while investment restrictions are less likely. This suggests that repeat borrowing and greater informational transparency makes these covenants more valuable. Rather than directly substituting for these direct contracting provisions, increased monitoring and information creates serves to increase the value of these provisions.

Several studies such as Bradley and Roberts (2004), Nini et al. (2009), and Murfin (2009) have sought to explain empirically what drives the use of debt covenants, but most studies either examine a particular provision in isolation or tend to describe the overall strictness of contracts in a uniform way. By contrast, this study seeks to highlight the large differences in how and why various types of accounting covenants are applied and to explain how firms weigh the costs and benefits of each.

In addition to examining claim holder agency conflicts, our paper builds upon literature on asymmetric information and maturity. A number of important works such as Myers and Majluf (1984), Flannery (1986), and Goswami et al. (1995) study the importance of asymmetric information in determining the type and maturity of funding. We extend these ideas by examining the ex-post tradeoffs created from a desire to fund projects internally. In a similar way, this paper is also related to the work on the value of internally generate cash flows and investment opportunities by Froot et al. (1993) and Acharya et al. (2007). Our paper seeks to highlight how the desire to retain internally generated cash flows interacts with the agency conflicts described by Jensen and Meckling (1976). In doing so, we illustrate how the structure of financial claims influences the ability of firms to manage this process.

Finally, in examining the role of covenants in shaping the value of information, our paper is related to recent work by Gârleanu and Zwiebel (2009). They present a model of covenant selection as a way of mitigating over-investment in the face ex-ante asymmetric information. However, our model differs significantly in its approach.

Gârleanu and Zwiebel (2009) model covenants as an ex-ante screening device which allows lenders to incorporate ex-post information into the screening mechanism. In our model, there is no asymmetric information at the time the contract is initiated, and information acquisition occurs by both the borrower and lender ex-post. In doing so, we attempt to explain firm's stated preference for investment flexibility and the value of banking relationships in shaping that preference.

The paper proceeds as follows. Section 2 describes the theoretical model. Section 3 presents empirical evidence for the implications of the model. Section 4 concludes the paper.

2.2 Model

The model has three periods, $t = 1, 2, 3$. In period 1, a wealth constrained entrepreneur E needs funding to undertake an investment project. He faces a competitive lending market, offering a break even loan contract to a bank B in return for an upfront investment k_0. Both E and B are risk neutral and the discount rate is assumed to be 0.

At $t = 1$, the debt contract is set. The loan contract specifies a face value of debt, F, which will be repaid in period $t = 3$. The face value of debt is set such that $E[F] = k_0$, so the entrepreneur captures the full surplus of the project. We restrict our investigation to debt contracts, under the assumption that debt has some value, such as tax benefits, which are outside the scope of this model. By forcing the debt to be due at t=3, we are also implicitly examining long-term debt contracts. In the section that immediately follows, we will motivate the use of long-term debt, but for most of the analysis which follows we will analyze the long-term debt contracts described here.

At $t = 2$, the firm realizes some interim cash flow, either c_H or c_L with equal probability, where $c_H \geq c_L$. After the cash flow is realized, a follow on investment becomes available which pays out $g(k)$ in period $t = 3$. The follow-on investment pays out $2k$ up to some maximum investment $k \leq b$ and pays out $2b$ when $k > b$. This investment function is thus weakly increasing and concave, where b represents the uncertain productivity factor which determines the optimal level of investment.

The productivity of the investment b is distributed $U[0, 2]$ and is unknown by either the entrepreneur or the bank at $t = 1$. Prior to choosing its investment at $t = 2$, the entrepreneur receives a noisy signal about the productivity. Specifically, the entrepreneur observes a signal β, which is accurate with probability p and random noise with probability $1 - p$. The bank also observes the entrepreneur's signal with some additional noise. After receiving the signal, the entrepreneur makes its investment decision and commits its available funds to the investment.

Any funds which are not invested in this is the last candidate. next esc will revert to uncompleted text. he follow on project can be costlessly saved into the last period. Equivalently, the funds may voluntarily be immediately repaid to the bank. However the entrepreneur cannot be forced to repay the bank early if he is not in violation of the contract. Here we implicitly assume that renegotiation is costly enough to preclude a complete restructuring of the contract prior to the investment.

At $t = 3$, the cash flows from the follow on investment are realized. The bank is paid the face value of debt F and the entrepreneur receives the remaining cash. If the final payout is insufficient to pay F, the bank receives the entire cash flow of the entrepreneur and the entrepreneur receives nothing.

The timeline is summarized below.

t=1

- The entrepreneur borrows k_0 from a competitive bank to finance an initial investment.
- The face value of debt, F is set such that $E[F] = k_0$, to be repaid at t=3.

t=2

- The entrepreneur realizes an interim cash flow $\tilde{c} \in \{c_H, c_L\}$, where $c_H \geq c_L$ and $Pr(c = c_H) = \frac{1}{2}$.
- A follow-on project becomes available which pays out $g(k) = \begin{cases} 2k & b \geq k \\ 2b & k > b \end{cases}$ at t=3. The distribution of the productivity parameter $\tilde{b} \sim U[0, 2]$ is known at t=1.
- The entrepreneur receives a noisy signal about the productivity of the follow-on investment. The bank observes the entrepreneur's signal with some additional noise.
- The entrepreneur chooses to invest k from in the project and save $c - k$ into the next period.

t=3

- Cash flows from the follow on investment are realized.
  The final payoff of the investment is $c + b - |b - k|$.
- The entrepreneur repays the debt F, if $F < b - |b - k| + c$; otherwise, he defaults and repays all of the existing cash.

2.2.1 Myopic Investment and Long Term Debt

The primary focus of our model is to examine how the use of covenants impacts the risk shifting behavior of the entrepreneur. As such, we are implicitly ruling out short-term debt, wherein the entrepreneur must fully refinance the debt at $t = 2$ prior to making the investment decision. Making the debt short term in this case is equivalent to making the debt fully callable by the bank at any time.

Long-term debt is often observed in practice, and several models such as Flannery (1986), Diamond (1991), Berglöf and von Thadden (1994), Acharya et al. (2010), and Brunnermeier and Oehmke (2010) establish the optimality of long term debt in the presence of asymmetric information, contracting costs, nonassignable control rents, and market-wide rollover risk. For completeness, we will first consider a version of the model with the addition of a moral hazard problem along the lines of von Thadden (1995). Here, we will show that long-term debt can solve the resulting problem of excessive investment myopia and therefore dominates short-term debt. Since the choice of long-term debt fully solves this dimension of the problem, we proceed to evaluate the model with long-term debt and will ignore the non-binding moral hazard problem.

To demonstrate the problem of myopic investment we simply allow that, upon making the initial investment, the entrepreneur is able to choose a short term strategy which pays out $c_H + \gamma$ instead of c_H when the high cash-flow state is realized at $t = 2$. Doing so renders the follow-on project worthless. This can be thought of as under-investing in maintenance, employee safety and support structures, customer service, etc in such a way that maximizes short-term profits but renders continuation prohibitively expensive.

At $t = 1$, the bank sets short term debt with face value F_{ST}, to be repaid at $t = 2$. The informational advantage of the bank and the resulting adverse selection problem requires the entrepreneur to rely on the bank to fully finance the follow on investment. If short term debt is used, and the face value is such that $c_L < F_{ST}$, the bank captures the full value of the follow-on project when c_L is realized.[2] If $c_H > F_{ST}$, the maximum value the entrepreneur can capture is the investment supplied by residual cash flow. If the entrepreneur's signal is close to uninformative, the ex-ante value of pursuing a long-term strategy is $2(c_H - F_{ST}) - \frac{1}{2}(c_H - F_{ST})^2$. If the entrepreneur's signal is close to fully informative, the ex-ante value of pursuing a long-term strategy is $2(c_H - F_{ST}) - \frac{1}{4}(c_H - F_{ST})^2$. Consequently, there exists some cutoff value $\gamma^* \in \left(c_H - F_{ST} - \frac{1}{2}(c_H - F_{ST})^2, c_H - F_{ST} - \frac{1}{4}(c_H - F_{ST})^2\right)$ such that short term debt induces an excessively myopic investment strategy.

The entrepreneur will prefer to have a contract in which he is able to freely invest internally generated cash flows which are free from asymmetric information problems. The informed entrepreneur will be able to fully capture the value of his information when he makes his investment. However, removing the threat of interim refinancing also gives the entrepreneur an incentive to shift risk onto the bank through over-investment.

We now proceed under the assumption that long-term debt is used, solving the problem of myopic investment, but introducing the resulting problem of future

[2]If $c_L > F_{ST}$, the debt is riskless and $F_{ST} = k_0$. The focus of this paper is on solving problems associated with risky debt, so this is not examined here.

over-investment.

2.2.2 Debt, Cash Flow, and the Investment Decision

Since the bank faces a break even profit condition, the surplus of the investment value accrues to the entrepreneur. The entrepreneur therefore chooses F to maximize the total expected value of the firm at $t = 1$, conditional on the equilibrium follow-on investment decision that will be made at $t = 2$. The expected value of the firm is given as follows:

$$E[firm] = \frac{c_H + c_L}{2} + k - \frac{1}{2}k^2. \tag{2.1}$$

This is the value of the period $t = 2$ cash flow plus the value of the follow-on investment. The investment k which maximizes total firm value, given by the first order condition of equation 2.1, is 1. This produces an expected value of $\frac{1}{2}$ for the follow on investment. Note that the optimal level of follow-on investment is independent of the realization of c because in this simplified model c contains no information about the outcome of the investment.

The investment choice made by the entrepreneur will be directly influenced by the cash flow realization in the second period relative to the face value of debt. For $c - F \geq 2$, the debt will always be fully repaid for any investment level up to the maximum possible productivity, and the debt is always rendered safe. The entrepreneur will internalize the entire value of the follow-on investment, and the bank will be indifferent to any level of investment. Conversely, for $c - F \leq -2$, the debt can never be fully repaid for any realized investment outcome and the bank will fully internalize the value of investment with the equity holder being indifferent to any investment level. For this reason, we focus on the interesting range where $-2 < c - F < 2$. We also assume that $c_L \geq 2$. This allows the entrepreneur to fully fund any desired investment with internal cash flows without having to solicit additional funds. This assumption doesn't substantially change the analsysis.

We now derive the level of investment which will be made in the follow-on investment in period 2 if the entrepreneur is in control of the investment decision and his signal is uninformative. This will provide a baseline case, which we will use to introduce the signal structure and its implication for decision making. Here and for much of the analysis, we take the face value of debt F as given rather than positing the initial investment level k_0 and solving for the face value of debt. This greatly simplifies much of the analysis, and in Appendix 2.5.1 we show that, for each region of $c - F$ considered here, there exists a region for k_0 that implies values for $c - F$ in said region.

Lemma 2.2.1. *If the entrepreneur controls the investment decision at $t = 2$, he will choose investment level k subject to the realization of cash flows c such that*

$$k = \begin{cases} 1 & c > 1 + F \\ \frac{4}{3} - \frac{1}{3}(c - F) & c \leq 1 + F \end{cases} \tag{2.2}$$

Proof. At $t = 2$, the intermediate cash flow c is realized and the follow on investment is made. The expected value of equity and the payoff to the entrepreneur is the expected value of $\max[c - k + g(k, \tilde{b}) - F, 0]$. This is reduces to $E[\max[\tilde{b} - |\tilde{b} - k| + c - F, 0]$. Integrating over the distribution of $\tilde{b}$ yields the following value

$$E[V_E] = \begin{cases} \frac{1}{8}(8 + c - F - 3k)(c - F + k) & c - F < k < c - F + 4 \\ c - F + k - \frac{k^2}{2} & k < c - F \\ 0 & \text{otherwise} \end{cases} \tag{2.3}$$

The value of the equity is maximized by investment $k = \frac{4}{3} - \frac{1}{3}(c - F)$ when $F - c < k$ and by $k = 1$ when $F - c > k$. The maximized equity value is greater for $F - c < k$ when $-2 < c - F < 1$ and greater for $F - c > k$ when $c - F \geq 1$.

□

The entrepreneur will over-invest, relative to the first best, for any cash flow realizations less than $F + 1$. The level of over-investment is also decreasing in c for this region. The investment distortion becomes greater when cash flows are low relative to the outstanding debt. The total value of the follow-on investment when the entrepreneur makes the investment choice is

$$E[V] = \begin{cases} \frac{1}{2} & c > 1 + F \\ \frac{1}{18}(4 - (c - F))(2 + c - F) & c \leq 1 + F \end{cases} \tag{2.4}$$

For all cash flow realizations $c < F + 1$, the equity holders will over invest, and produce a firm value strictly less than the first best value of $\frac{1}{2}$.

Lemma 2.2.2. *The first best firm value can be achieved by allowing equity to retain control and setting the maximum allowable investment to the socially optimal level,* $k = 1$. *Equivalently, the first best can also be achieved by setting the maximum allowable investment to the socially optimal level for all realizations of* c*, where* $F -$

$c < 1$. *This can be achieved by specifying an interim repayment, conditional on the cash flow realizations, of* $c - 1$ *for all* $F - c < 1$.

Proof. Since the value of equity is always weakly increasing in k for all $k \leq \frac{1}{2}$, the entrepreneur will always invest the socially optimal level if its investment is capped. For $F - c > 1$, the entrepreneur will choose the socially optimal level regardless of the level cash flow realization.

Since the entrepreneur cannot raise funds which are senior to the existing debt, this cap can be achieved by requiring the entrepreneur to immediately repay the bank such that it's cash available for investment is the socially optimal level. Since the entrepreneur will always invest up to 1, it is sufficient to specify repayment $c - 1$ such that the entrepreneur's investable funds are the optimal amount. $\square$

Note that a maximum investment restriction effectively solves the classic over-investment problem without any additional restrictions. The widespread existence of covenants which restrict maximum investment has been seen as evidence of the significance of the over-investment problem and, by extension, the costs of renegotiation and short term debt. If renegotiation were costless, the standard risk-shifting problem could be effectively mitigated by simply renegotiating the terms of debt in the second period. In the presence of renegotiation costs, explicit investment restrictions return investment to the first best.

What is puzzling then is that such investment covenants are not more universal. In a sample of 3,720 private credit agreements Nini et al. (2009) found that less than a third contained some type of investment restriction and that these restrictions were primarily concentrated among low quality borrowers. Financial officers also appear to view these restrictions very negatively, arguing that they restrict flexibility in future investment decisions.

These facts suggest that some form of private information must be influencing future investment and the terms of financing. In order for investment flexibility to have value, the optimal investment level must change according to new information received by the entrepreneur. To examine this idea, we will extend the model to capture the arrival of private information during the course of operations.

2.2.3 Information

We model the importance of information by allowing the entrepreneur to receive a signal about the productivity of the investment at $t = 2$, prior to making the follow-on investment. Specifically, the entrepreneur receives a signal $\beta \in [0, 2]$ which is equal to the productivity with probability p_E and completely uninformative (and uniformly distributed over $[0, 2]$) with probability $1 - p_E$. The equity holder does not know whether he has received the accurate signal or the the noise signal. The informativeness of the signals is known by both parties at $t = 1$.

The bank may observe this signal with some noise. The bank observes β', which equals β with probability p' and is completely uninformative, i.e. randomly distributed $U[0, 2]$, with probability $1 - p'$. Effectively, this gives the bank a similar but less precise signal whose informativeness can be expressed as $p_B = p_E \times p'$. This implies that $p_E \geq p_B$. Importantly, the bank is not generating any new information that the entrepreneur does not already know. The value of the bank's monitoring is embedded not in its own internal information generation, but in how well it is able to verify the entrepreneur's private information.

The purpose of this signal is to model the acquisition of private information that is generated by the entrepreneur during the operation of his business and the acquisition of information generated by the bank through monitoring. The entrepreneur's signal is privately observable to the entrepreneur and the bank's signal is privately observable to the bank at $t = 2$, but neither signal is verifiable and neither signal can be credibly conveyed to the outside market. This signal is also independent of the intermediate cash flow realization.

In the presence of a signal β with precision p, the payout of the follow on investment is

$$\begin{cases} \beta - |\beta - k| & \text{with probability } p \\ k - \frac{1}{2}k^2 & \text{with probability } 1 - p \end{cases}$$

and the expected value of the investment is given by

$$E[V] = p_E(\beta - |\beta - k|) + (1 - p_E)(k - \frac{1}{2}k^2) \tag{2.5}$$

The investment choice which maximizes firm value is obtained in the usual way by setting the derivative of $E[V]$ equal to zero and solving for k^*. The optimal investment k^* varies between β and a weighted average of β and the unconditional optimum $k = 1$, depending on the realization informativeness of the signal. Since the value equation is discontinuous at $k = \beta$, we solve for the optimal k in a piecewise equation.

When the p is below some threshold value, the optimal investment will be a weighted average of the signal β and the unconditional optimum. When the value of p above this threshold, the optimal investment will be exactly β.

$$k^* = \begin{cases} 1 - \frac{p}{1-p} & 0 \leq \beta \leq 1 \text{ and } p \leq \frac{\beta-1}{\beta} \\ 1 + \frac{p}{1-p} & 1 < \beta \leq 2 \text{ and } p \leq \frac{\beta-1}{\beta-2} \\ \beta & \text{otherwise} \end{cases} \tag{2.6}$$

The ex-ante expected value of the investment is monotonically increasing in p, as the investment decision becomes more precise. For any signal precision $\frac{1}{2} < p < 1$, the investment which maximizes firm value is always β, and the ex-ante expected value of the follow on investment is $\frac{1}{3}(1+2p)$. When $p = 1$, the full information case, the project is twice as valuable as under the ignorant investment.

2.2.4 Contingent Investment Decisions

Having derived the period 2 investment decision of the entrepreneur, we now derive the baseline case for the investment decision of the bank if it possessed control over the investment decision. As in the entrepreneur's case, we describe the uninformed case as a baseline, which we will use to set up the informed case.

Lemma 2.2.3. *If the bank controls the investment decision at $t = 2$, it will choose investment level k subject to the realization of cash flows c such that*

$$k = \begin{cases} 1 & -1 \leq c - F \\ F - c & -1 < c - F \leq 0 \\ [0, c - F] & 0 < c - F \leq 1 \end{cases} \tag{2.7}$$

Proof. The expected payoff to the bank at $t = 2$ is $E[\min[\tilde{b} - |\tilde{b} - k| + c, F]$. Integrating over the distribution of $\tilde{b}$ yields the following

$$E[V_B] = \begin{cases} F & k < c - F \\ c + k - \frac{k^2}{2} & k < F - c \text{ and } c - F < 0 \\ F - \frac{1}{8}(k - c + F)^2 & k > F - c \text{ and } c - F < 0 \end{cases} \tag{2.8}$$

When $c - F \leq -1$ the investment value is greatest for $k < F - c$ and the value is maximized at $k = 1$. When $-1 < c - F < 0$, the value of the bank's claim is increasing in k for both $k > F - c$ and $k < F - c$. The optimal investment is therefore $k = F - c$. For any investment $k < c - F$, the debt is rendered completely safe and the expected value is always F. Since the value of the bank debt is bounded at F and $k \geq 0$, the bank is indifferent between any level of investment between 0 and $c - F$ when $F - c > 0$

□

The asymmetric payoff of the debt claim causes an opposite investment distortion when the bank is in control. Since the banks upside is capped, the bank has an incentive to under-invest relative to the first best. Additionally, the incentive to under-invest is lower for low cash flow realizations. Consequently, the bank's investment policy is closer to the first best when cash flows are low.

The value of the follow on investment if the bank is in control is given by

$$E[V] = \begin{cases} \frac{1}{2} & \text{for } -1 \leq c - F \\ (F - c) - \frac{1}{2}(F - c)^2 & \text{for } -1 < c - F \leq 0 \\ \left[0, (c - F) - \frac{1}{2}(c - F)^2\right] & \text{for } 0 < c - F \leq 1 \\ \left[0, \frac{1}{2}\right] & \text{for } 1 \leq c - F \end{cases} \tag{2.9}$$

Note that when $c > F$ it is possible to make the debt completely safe and still have positive investment. In this case, the bank is indifferent between a continuum of investment levels. When cash flows are high enough to fund the socially optimal investment $k = 1$ and keep the debt safe, the value can return to the first best. Unlike the value under the entrepreneur control however, the value under bank control is not unique.

The primary friction in this model results from the convexity of the claim held by the entrepreneur and the concavity of the claim held by the bank. Because the equity holder does not always bear the full cost of over-investment, he has an incentive to over invest in the follow-on project. Conversely, since the bank does not always capture the full upside of investment, it will have an incentive to under invest in the follow-on project. This is similar to the intuition provided by Dewatripont and Tirole (1994) who use these conflicting incentives as a means of achieving credible ex-ante discipline to managers.

If the equity holder is allowed to make the follow on investment decision, he will invest more than the firm maximizing level of investment for cash flow realizations $-2 < c - F < 1$. If the bank is allowed to choose the follow on investment decision, it will invest always invest less than the firm maximizing level of investment for cash flow realizations $-1 < c - F < 1$. When cash flows are sufficiently low, the entrepreneur over-invests in the project. This investment is optimal from the point of view of the equity holder at $t = 2$, but is value destroying from an ex-ante perspective. Conversely, if the bank is allowed to control the investment decision, it will tend to under invest for relatively high cash flow realizations.

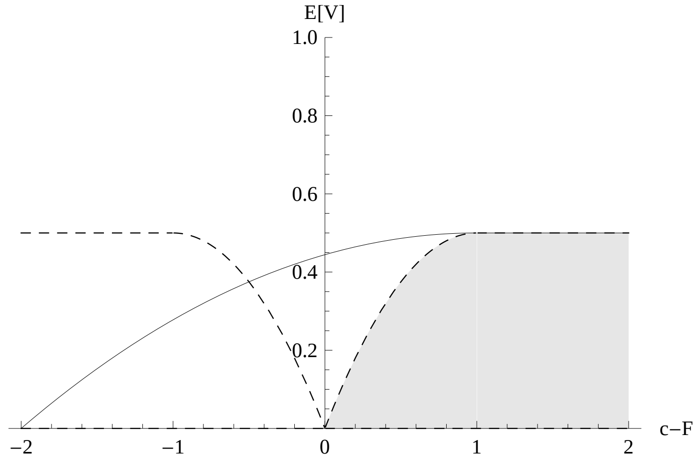


Figure 2.1: Value of follow on investment as a function of $c - F$. The solid line represents equity control and the dashed line represents bank control. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

The value of the follow-on project, has a function of $c - F$ is shown in Figure 2.1. When cash flow falls below $F + 1$, the entrepreneur finds it optimal to over invest in the project as a function of $c - F$. Conversely, the bank finds it optimal under invest in the follow on project to preserve the safety of its debt claim. When $c - F$ falls below 0, the bank faces a tradeoff between investing up to a level which will fully repay the debt and preserving the existing capital base.

Note that the investment decision of the bank is decreasing in $c - F$ from -1 to 0, and potentially increasing after $c - F > 0$. This is a function of the fact that once cash flow is sufficient to fully repay the face value of debt, the bank becomes indifferent to *any* investment level which will keep its claim safe. This is partially a function of our simplifying assumption of a bounded distribution of possible project outcomes. For *some* unbounded distributions, the investment level is always be monotonically decreasing in $c-F$. However, this is not critical to our analysis since the bank's investment choice is always weakly dominated by the equity holder's investment choice for high cash flow realizations.

It will be useful to define the difference between the realized cash flow at $t=2$ and the face value of debt as $\delta \equiv c-F$. Assume that the bank will choose the investment level preferred by the entrepreneur when it is indifferent between a range of investments. From equations (2.4) and (2.9), the expected value of the follow on investment satisfies the following inequalities:

E Control		B Control	δ
$\frac{1}{2}$	$=$	$\frac{1}{2}$	for $1 \leq \delta$
$\frac{1}{9}(4+\delta-\frac{\delta^2}{2})$	$>$	$\delta-\frac{1}{2}\delta^2$	for $0<\delta \leq 1$
$\frac{1}{9}(4+\delta-\frac{\delta^2}{2})$	$>$	$-\delta-\frac{1}{2}(-\delta)^2$	for $-\frac{1}{2}<\delta \leq 0$
$\frac{1}{9}(4+\delta-\frac{\delta^2}{2})$	$<$	$-\delta-\frac{1}{2}(-\delta)^2$	for $-1<\delta \leq -\frac{1}{2}$
$\frac{1}{9}(4+\delta-\frac{\delta^2}{2})$	$<$	$\frac{1}{2}$	for $-2 \leq \delta \leq -1$

For $t=2$ cash flow realizations such that $\delta \geq -\frac{1}{2}$, the expected value of the firm is weakly larger under entrepreneur control. For cash flow realizations such that $\delta < -\frac{1}{2}$, the expected value of the firm is larger under bank control. This naturally leads to a value for transfer of control over investment contingent on cash flow realizations, which we establish in the following result.

Proposition 2.2.4. *Contracts which let the bank make the investment decision upon the realization of c_L and entrepreneur control upon the realization of c_H:*

- *Increase the expected value of the entrepreneur's claim at $t=1$ for all* $c_L < \frac{1}{9}\left(10+9k_0\right)-\frac{68\sqrt{2}}{81}$

- *Decrease the expected value of the entrepreneur's claim at $t = 1$ for all $c_L > k_0 - \frac{1}{2}$*

As $c_H - c_L$ increases, the threshold c_L increases from $\frac{1}{9}(10 + 9k_0) - \frac{68\sqrt{2}}{81}$ to $k_0 - \frac{1}{2}$.

Proof. See Appendix

The value of this control transfer mechanism explicitly models the cash flow covenants commonly found in bank loan contracts. More importantly, it illustrates that these cash flow covenants are only valuable when expected cash flows are sufficiently low relative to the face value of debt. This provides some basic intuition as to why cash flow covenants are less likely to be observed in loans to companies with consistent cash flows and very little financial risk. While control transfer provisions allow for a lower face value of debt, they also create an under-investment problem which dominates the potential over-investment problem when the cash flow is relatively high.[3]

Conversely, when expected cash flows are very low relative to the face value of debt, equity control may be infeasible. From equation (2.22), when $k_0 > \frac{4}{13} + c_H$, bank debt financing is infeasible when the entrepreneur retains control for c_H.

[3] Note that the cash flow threshold implies a threshold value for $c - F < -\frac{1}{2}$. This is because both c_H and c_L are in the risk shifting range for both the entrepreneur and bank. Allowing a transfer of control has two effects, changing the investment policy when $c = c_L$ and lowering the face value of debt. Around $c - F = -\frac{1}{2}$, the marginal decrease in firm value due to a decrease in F under bank control is slightly larger than the marginal increase under equity control. The optimal threshold must account for this fact, and the tradeoff involves comparing outcomes of $c_L - F$ slightly less than $-\frac{1}{2}$ under full entrepreneur control and slightly greater than $-\frac{1}{2}$ under contingent control.

The value of debt for $c = k_0 - \frac{4}{13}$ under bank control is given by

$$\frac{1}{8}\left(-4(c-F)^2 + 8F\right) = \frac{1}{13}(4 + 13c) \Leftrightarrow F = \frac{1}{13}\left(13 + \sqrt{65} + 13c\right)$$

Total firm value is thus equal to $c + \frac{4}{13}$. Total firm value when control is retained by the equity holder when c_H is realized, given by plugging $c = k_0 - \frac{4}{13}$ into equation (2.22) is $c + \frac{64}{169}$, indicating that though bank control is feasible, it is also less efficient. However as the value of c_H decreases, the difference between the realized cash flows and the face value of debt increases, which also increases the efficiency of the bank's investment decision.

For firms which are highly likely to default, equity control is not possible even when made contingent on cash flow realizations. By extension, loan contracts to the riskiest of firms are less likely to include a cash flow covenant and more likely to specify some direct role for the bank in dictating investment policy.

2.2.5 Private Information and the Optimality of Cash Flow Covenants

While the baseline case demonstrates that contingent control over investment may dominate entrepreneurial control, both cases are weakly dominated by an ex-ante restriction on investment as demonstrated in Lemma 2.2.2. We now examine the influence of private information on the investment decision and demonstrate the conditions under which contingent control may dominate investment restrictions.

The optimal investment decision for the privately informed entrepreneur at $t = 2$ is more complicated since, depending on the realization of c, he may mix between four different investment choices and will fully ignore all values of β which imply that he cannot repay the debt at $t = 3$. The expected value of the investment is monotonically increasing in p_E, though at a weakly lower rate than the socially optimal value because of the fact that the entrepreneur is under-weighting low realizations of β.

For any given cash flow realization such that of $-2 < \delta < 2$ and $0 < p_E < 1$, the entrepreneur's investment will be one of six possible choices:

$$1 - \frac{p}{1-p} \tag{2.10}$$

$$1 + \frac{p}{1-p} \tag{2.11}$$

$$\frac{4-\delta}{3} \tag{2.12}$$

$$\frac{4-(1-p)\delta}{3-3p} \tag{2.13}$$

$$\frac{4-8p-\delta+p\delta}{3-3p} \tag{2.14}$$

$$\beta \tag{2.15}$$

For high δ and low p_E, the entrepreneur will have no incentive to risk shift and will invest the socially optimal investment level given in equations (2.10) and (2.11). The entrepreneur in this case takes into account both the possibility that his signal is correct and the possibility that it is wrong.

Thus, the optimal investment lies in the convex hull of the optimal choice

Because of the analytical complexity of the entrepreneurs choice, we will focus on a range of signal informativeness $\frac{1}{2} \leq p_E < 1$. This reduces the potential investment choices to two expressions and allows for a tractable analytical expression for the ex-ante expected value.

Lemma 2.2.5. *For any signal precision $\frac{1}{2} < p_E < 1$, the entrepreneur will invest $k = \frac{4}{3} - \frac{1}{3}\delta$ for all $0 \leq \beta < \beta^*$, where $\beta^* = \frac{4-\delta+p\delta-4\sqrt{-p(-2+p-\delta+p\delta)}}{3-3p}$, and β otherwise.*

Proof. If the signal β is uninformative, the entrepreneur can capture no more than the full value of the firm. Therefore, the maximum possible threshold p_E below which the entrepreneur will prefer to mix is $p_E = \frac{1}{2}$, given by the solution to the socially optimal value in equation 2.5. Thus for any signal β, the entrepreneur's claim is maximized either by investing β or investing at the ignorant risk-shifting optimum of $\frac{4}{3} - \frac{1}{3}\delta$.

If the entrepreneur invests β, the expected value of his payoff will be as follows:

$$E[V_E] = \begin{cases} p_E\left(\max[\beta+\delta, 0]\right) + (1-p_E)(\beta - \frac{1}{2}\beta^2 + \delta) & \text{if } \beta < \delta \\ p_E\left(\max[\beta+\delta, 0]\right) + (1-p_E)\frac{1}{8}(8+\delta-3\beta)(\delta+\beta) & \text{if } \beta > \delta \end{cases}$$

If the entrepreneur invests $\frac{4}{3} - \frac{1}{3}\delta$, the expected value of his payoff will be:

$$E[V_E] = p_E\left(\max[2\beta - \frac{4}{3}(1-\delta), 0]\right) + (1-p_E)\frac{1}{6}(2+\delta)^2$$

For all $\beta < -\delta$, $\max[\beta+\delta, 0] = \max[2\beta - \frac{4}{3}(1-\delta), 0] = 0$. Because $(\beta - \frac{1}{2}\beta^2 + \delta) \leq \frac{1}{8}(8+\delta-3\beta)(\delta+\beta)$, the following inequality must be satisfied for the entrepreneur to prefer investing β:

$$\frac{1}{8}(8+\delta-3\beta)(\delta+\beta) > \frac{1}{6}(2+\delta)^2$$

This inequality can never be satisfied for $\beta < -\delta \leq \beta^*$ so the entrepreneur will always invest the ignorant optimum.

For $\beta > \frac{2}{3}(1-\delta)$, $\max[\beta+\delta, 0] > 0$ and $\max[2\beta - \frac{4}{3}(1-\delta), 0] > 0$. For the entrepreneur to prefer an investment of $\frac{4}{3} - \frac{1}{3}\delta$ the following inequality must be satisfied when $\beta < \frac{4}{3} - \frac{1}{3}\beta$:

$$p_E\,(\beta+\delta) + (1-p_E)(\beta - \tfrac{1}{2}\beta^2 + \delta) < p_E\left(2\beta - \tfrac{4}{3}(1-\delta)\right) + (1-p_E)\tfrac{1}{6}(2+\delta)^2$$

When $\beta > \frac{4}{3} - \frac{1}{3}\beta$, the following inequality must be satisfied:

$$p_E\,(\beta+\delta) + (1-p_E)(\beta - \tfrac{1}{2}\beta^2 + \delta) < p_E\left(\tfrac{4}{3}(1+\delta)\right) + (1-p_E)\tfrac{1}{6}(2+\delta)^2$$

Neither inequality can be satisfied for $\beta > \frac{2}{3}(1-\delta) \geq \beta^*$, so the entrepreneur will always invest β.

For the remaining case $-\delta < \beta < \frac{2}{3}(1-\delta)$, the following inequality must hold for the entrepreneur to invest β.

$$p_E(\beta+\delta) + (1-p_E)\frac{1}{8}(8+\delta-3\beta)(\delta+\beta) \geq (1-p_E)\frac{1}{6}(2+\delta)^2 \tag{2.16}$$

This is satisfied when $\beta \geq \beta^* = \frac{4-\delta+p\delta-4\sqrt{-p(-2+p-\delta+p\delta)}}{3-3p}$

□

When information is introduced at $t=2$, the standard risk-shifting problem takes on a new dimension. When cash flows are low, the equity holder is ignoring signals which imply a low value of future investment. This makes his information less valuable ex-ante, since he will only take advantage of the information when the signal is high. However, the information also serves to partially mitigate the original risk-shifting problem because the information makes the project less uncertain and therefore less risky.

We now establish the investment choice for the bank in the presence of a similar signal.

Lemma 2.2.6. *For any signal precision $\frac{1}{2} < p_B < 1$ and $-2 < \delta < 0$, the bank will invest $k = -\delta$ for all $\beta \geq -\delta$ and $k = \beta$ otherwise. The total value of the follow on investment is increasing in p_B.*

Proof. From equation (2.8), the bank's investment decision maximizes the following value:

$$p_B(\beta - |\beta - k| + c) + (1 - p_B)\left(c + k + \frac{1}{2}k^2\right) \tag{2.17}$$

for $k < -\delta$.

Since the expected maximum value is the full value of the firm, the maximum possible threshold p_E below which the bank will prefer to mix is $p_E = \frac{1}{2}$. Therefore, the bank will always invest β up to $\beta = -\delta$. When $\beta > -\delta$, the maximum value of bank's claim becomes

$$p_B(F) + (1 - p_B)\left(c - \delta + \frac{1}{2}(-\delta)^2\right) \tag{2.18}$$

and the entrepreneur always invests $-\delta$.

The expected value of the follow on project under bank control is therefore

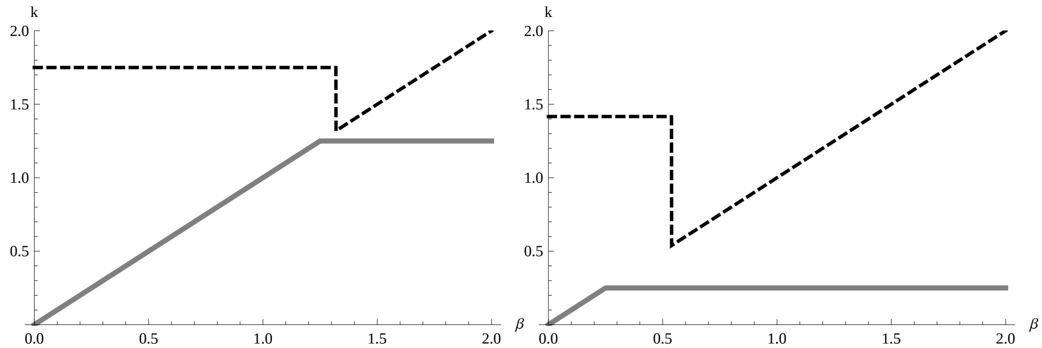
$$\frac{1}{12}\left(-12\delta - 9\delta^2 - 2\delta^3 + 6\delta^2 p_B + 2\delta^3 p_B\right) \tag{2.19}$$

which is increasing in p_B. □

When the bank has control, the bank's investment policy varies in a similar, inverse fashion. When $\delta < 0$, the bank will invest the socially optimal value k^* when $k^* < |\delta|$ and $|\delta|$ otherwise. When $\delta > 0$, the bank will be willing to invest any amount up to δ which keep the bank safe. Since the bank is indifferent, we will assume that the bank will invest k^* when $\delta \geq \beta_B$ and δ otherwise.

The investment policy is illustrated in Figures 2.2 and 2.3. When cash flow is high relative to the face value of debt, the banks investment policy ignores a greater fraction of signals than the entrepreneur since the bank internalize less of the upside. When cash flow is low the reverse is true, and the entrepreneur effectively ignores all but the highest values of β. As shown in Figure 2.3, the range of signals for which the entrepreneur over-invests shrinks for more informative signals.

Under equity control, the expected value of the follow on project increases with p_E, and the threshold cash flow over which the entrepreneur chooses to over-invest shrinks. As shown in Figure 2.4a, this also has the effect of reducing the threshold cash flow for which bank control dominates equity control. Figure 2.4b illustrates the project value when the bank has a similarly informative signal, increasing the threshold cash flow for which bank control is optimal, relative to the case with the uninformed bank.



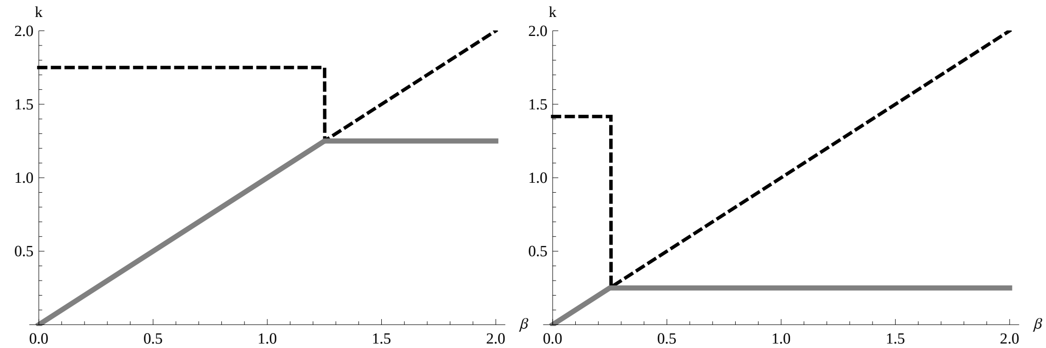
(a) $\delta = -\frac{5}{4}$ (b) $\delta = -\frac{1}{4}$

Figure 2.2: Investment policy as a function of the signal β when $p_E = p_B = \frac{1}{2}$. The dashed line represents the investment policy of the equity and the gray line represents the policy of the bank.

When the bank's signal is informative, an increase in p_B has the effect of increasing the value of bank control in low cash flow states. As demonstrated in Figure 2.4b, when the bank is similarly informed, the threshold value of δ for which bank control dominates equity control shifts back to the right relative to the uninformed case. This also has the effect of increasing the value of the control transfer provision, since the bank's investment policy dominates the entrepreneur's over a greater range of cash flows.

2.2.5.1 The Value of Investment Restrictions With Informative Signals

When the optimal investment decision is unknown at the time the loan contract is signed, any cap on investment will be unable to generate the first best level of investment for all possible signals. To illustrate this, note that the entrepreneur makes the socially optimal investment decision for all $\beta > \frac{4}{3} - \frac{1}{3}\delta$. To

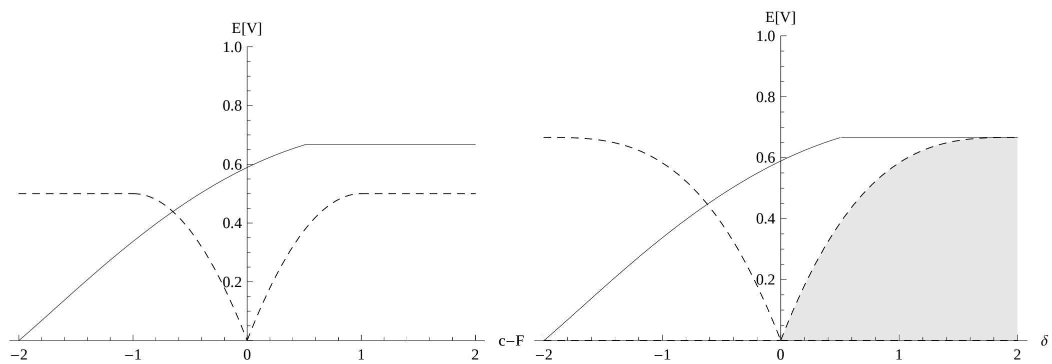


(a) $\delta = -\frac{5}{4}$ (b) $\delta = -\frac{1}{4}$

Figure 2.3: Investment policy as a function of β when $p_E = p_B = .99$ The dashed line represents the investment policy of the equity and the gray line represents the policy of the bank.

limit the over-investment of the entrepreneur, any maximum investment restriction which prevents over-investment for low realizations of β must also lead to significant under-investment for high realizations of β. Moreover, an unconditional restriction which is optimal in a low cash flow state must be sub-optimal for high cash flow realizations.

As p_E increases, the range of cash flow realizations over which ex-ante investment restrictions are value increasing shrinks. Note that as p_E increases, the threshold condition given in equation (2.16) becomes easier to satisfy for all $\beta > -\delta$. This reduces the cost of over-investment by reducing the range of β realizations for which over-investment occurs. Consequently, the value creation of any ex-ante investment cap will be value creating for smaller δ. For high p_E, ex-ante investment restrictions are only valuable for firms with very low expected cash flows. Consequently, covenants which restrict maximum investment will only be employed firms



(a) $p_E = \frac{1}{2}$ and $p_B = 0$ (b) $p_E = p_B = \frac{1}{2}$

Figure 2.4: Value of follow on investment as a function of δ. The solid line represents equity control when and the dashed line represents bank control. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

with the greatest risk of default.

Proposition 2.2.7. *As p_E approaches one, ex-ante investment restrictions are value destroying for all $\delta > -\frac{4}{5}$. The threshold δ for which ex-ante investment restrictions are value creating decreases with the informativeness of the bank signal p_B. For $p_B > \frac{1}{2}$, ex-ante investment restrictions are never optimal.*

Proof. For any p strictly less than one, the entrepreneur continues to discard signals of β which imply default at $t = 3$, but will place full weight on all signals which imply a positive profit. Thus, as $p \to 1$, the entrepreneur will invest $\frac{4}{3} - \frac{1}{3}\delta$ for all $\beta < -\delta$ and β otherwise. In this case, the value of the follow-on project at the socially optimal level of investment is 1 and the expected value under equity control is $\frac{1}{12}\left(12 + 8\delta + \delta^2\right)$.

In order for an ex-ante investment restriction to be valuable, the investment must be restricted to less than $k = \frac{4}{3} - \frac{1}{3}\delta$ for any given cash flow outcome $-2 < \delta < 0$, since all investments above this level imply the entrepreneur is investing the optimal level of investment β. The restriction must also be weakly greater than the unconditional optimum, $k = 1$ since this is the best that can be achieved in the no-information case given by Lemma 2.2.2.

The value of the follow on project with the investment restriction $k_{\max}$ is thus given by:

$$\int_0^{-\delta} (2\beta - k_{\max})\frac{1}{2}d\beta + \int_{-\delta}^{k_{\max}} (\beta)\frac{1}{2}d\beta + \int_{k_{\max}}^{2} (k_{\max})\frac{1}{2}d\beta$$
$$= \frac{1}{4}\left(2k_{\max}\delta + \delta^2 + 4k_{\max} - k_{\max}^2\right)$$

The investment restriction which maximizes the value of the firm is $k_{\max} = 2 + \delta$ for $-1 < \delta < 0$ and $k_{\max} = 1$ for $\delta \leq -1$. This gives a firm value of $1 + \delta + \frac{1}{2}\delta^2$ for $-1 < \delta < 0$, $\frac{1}{2}$ for $\delta \leq -1$, and 1 for $\delta \geq 0$.

The difference between the maximum restricted and unrestricted value of the follow on investment is given by

$$1 + \delta + \frac{\delta^2}{2} - \frac{1}{12}\left(12 + 8\delta + \delta^2\right) \tag{2.20}$$

and is negative for $\delta > -\frac{4}{5}$.

If the bank is uninformed, the optimal transfer of control occurs when $\frac{1}{12}\left(12 + 8\delta + \delta^2\right) = -\delta - \frac{1}{2}(-\delta)^2$ implying a $\delta_{cf} = \frac{6}{7}$ Thus, in the presence of cash flow covenants, investment covenants may be value increasing only for $-\frac{6}{7} < \delta < -\frac{4}{5}$.

From Lemma 2.2.6, the value of investment is increasing in the informativeness of the bank's signal. As the bank's signal increases the δ^* threshold also increases. For $p_b = \frac{1}{2}$, the cash flow threshold $\delta_{cf} > -\frac{4}{5}$ and thus an investment covenant is never optimal. □

The practical implication of this result is that, when the entrepreneur's non-contractable signal is sufficiently informative, ex-ante investment restrictions are value destroying for high cash flow realizations. When the bank's non-contractable signal is sufficiently informative, ex-ante investment restrictions are never optimal.

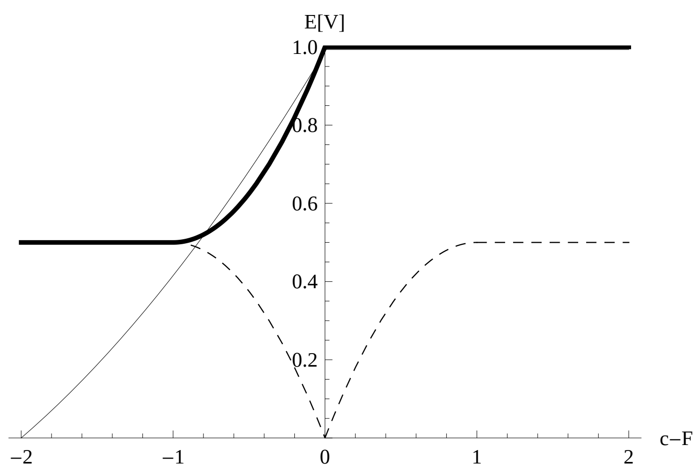


Figure 2.5: Value of follow on investment as a function of δ. The solid line represents equity control as $p_E \to 1$ and the dashed line represents bank control when $p_B = 0$. The thick line represents equity control under the optimal investment restriction. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

The basic results are illustrated in Figure 2.5, for p_E close to 1. When p_E is close to 1, the entrepreneur over-investment region is $-2 < \delta < 0$. The black line represents firm value under the best possible investment restriction for all known values of δ, possible only if $c_H \approx c_L$ or if investment restrictions can be made contingent on realizations of c. Firm value is lower under an investment restriction for all realizations of $\delta > -\frac{4}{5}$. By extension, investment covenants are valuable only when all potential cash flow realizations are low relative to the face value of debt and the entrepreneur has a high likelihood of default. Note also that a contingent control provision based on cash flow realizations is value enhancing for $c_L < F - \frac{6}{7}$, regardless of c_H.

2.2.5.2 The Value of Cash Flow Contingent Control with Informative Signals

Finally, we examine how the value of private bank information affects the value of loan contract provisions. Note that as the bank's signal becomes more informative, the value of the follow-on project increases for all $\delta \neq 0$. This has the effect of both raising the optimal cash flow threshold for contingent control and increasing the total value created by the provision. This leads to our final two results.

Proposition 2.2.8. *The threshold realization of c, such that transfer of control to the bank is value increasing, is decreasing in p_E for all $\frac{1}{2} < p_E < 1$. The threshold realization of c, such that transfer of control to the bank is value increasing, is increasing in p_B for all $\frac{1}{2} < p_B < 1$.*

Proof. See Appendix. □

Proposition 2.2.9. *As the bank's signal becomes more informative relative to the entrepreneur's signal, the value of cash flow contingent control increases.*

Proof. From equation (2.24), the value of the follow on investment is increasing in δ from $-2 < \delta < \delta^* < 1$, from 0 to 1. From equation (2.19), the value under bank control is decreasing in δ from $2 < \delta < 0$ from $\frac{1}{3}(1 + 2p)$ to 0.

Since $p_B \leq p_E$, the value of control transfer is decreasing in $p_E - p_B$. Thus cash flow covenants are more valuable when the entrepreneur and bank have similar high levels of private information. $\square$

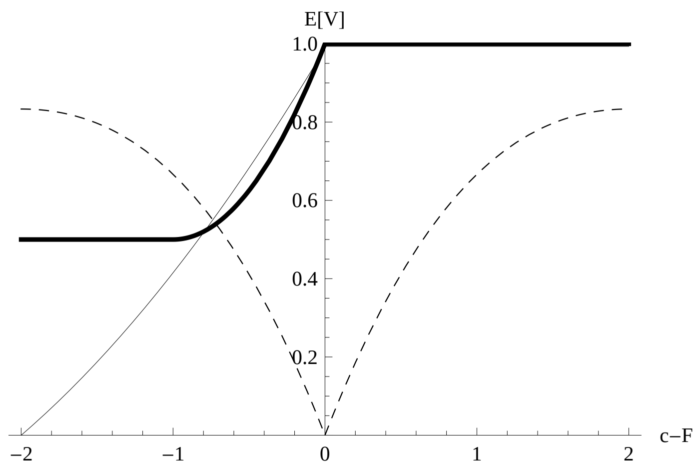


Figure 2.6: Follow on value of firm as a function of δ. The solid line represents equity control as $p_E \to 1$ and the dashed line represents bank control when $p_B = \frac{2}{3}$. The thick line represents equity control under the optimal investment restriction. The shaded area notes that for this region, bank control represents a set of possible values, bounded by the dashed line.

The basic results are illustrated in Figure 2.6. When p_B increases, the crossing point of value creation by the entrepreneur and value creation by the bank shifts to the right relative to the uninformed case in Figure 2.5. This increases the optimal threshold for a change in control such that the unrestricted value created by either party is always greater than the restricted value created under an ex-ante investment restriction. The total value created for any cash flow realization under contingent control also increases. Note that the value also always strictly greater than the value under the best possible investment restriction. This implies that the value of investment covenants decrease and the value of cash flow covenants increases when bank's discover more information over the course of the loan. Because of this, we should expect to see fewer investment covenants among firms with close, repeated banking relationships. Conversely, we should also expect to see more cash flow covenants for these firms.

2.3 Empirical Tests

Our theoretical results predict a monotonic relationship between investment covenants and default risk. Firms more likely to default and those with low expected short term cash flows relative to the size of investment will be more likely to face investment covenants since the value of allowing investment discretion by the firm disappears. Specifically, the firm will almost always choose to risk shift, and as such there is no value in leaving discretion to the firm even when its signal is reasonably precise.

For cash flow covenants, the relationship is more complex. When the risk of default is low, there is little value in restricting the entrepreneur's actions after low cash flow realizations. However, when the risk of default is high, the bank should restrict the investment decision of the entrepreneur regardless of the cash flow realization. The cash flow covenant is superfluous or value destroying since it places control in the hands of the less informed bank.

A second implication of the model is that banks with better information should choose cash flow covenants more often than those with less information. If this is the case, we argue that banks develop more precise signals about the value of their clients' investments as they develop long term relationships with them. Therefore, repeated banking relationships should make the inclusion of cash flow covenants more likely and make investment restrictions less likely.

The data on loan contracts come from the Dealscan loan database, provided by the Loan Pricing Corporation. Our data set contains detailed information on the terms of commercial bank loans made to corporations from 1988 to 2007. We restrict our sample to the subset of deals which have information about financial covenants. We obtain firm financial information from the Compustat annual file, which is matched to each loan for the period in which the loan was initiated.

We focus on financial covenants which deal with investment restrictions and maintenance cash flows as a function of outstanding debt. Interest coverage covenants mandate that the firm maintain cash flows at some threshold value above of the interest due on the loan. Similarly, debt-to-cash-flow covenants require a cash flow maintenance with respect to the total debt amount. Capex covenants place some explicit limitation on the maximum amount of investment by the firm. Leverage covenants place restrictions on the total allowable debt the firm may have. Sweep provisions mandate the repayment of the loan, or some proportion thereof, whenever cash is raised through either future debt issuance, equity issuance, or asset sales. Specifically, they specify that a percentage of any future funds raised must be used to retire the outstanding debt obligation.

Summary statistics are reported in Table 2.1. Interest coverage and debt-to-cash-flow covenants are the most common provisions, followed by leverage restrictions and sweep provisions. Table 2.2 presents the correlation of each group of covenants. Debt to cash flow covenants and interest coverage covenants are highly correlated, suggesting that loan contracts which specify cash flow maintenance tend to make these requirements explicit functions of both the total face value of debt and the periodic debt payments. The correlation between leverage restrictions and most other types of covenants is negative. This suggests that leverage restrictions act as substitutes for other contracting provisions, forcing the leverage of the firm to remain at levels for which agency conflicts are less relevant.

Our model predicts that investment restrictions will be most common in loans to low cash flow companies with high default probabilities, while cash flow related covenants will be more common for companies with moderate cash flows and less common for those with very high and very low default probabilities. Table 2.3 presents the occurrence of specific debt covenants for the subset of firms which have public debt ratings. The fraction of firms with cash flow covenants and capex restrictions is much lower for investment grade debt ratings (at or above BBB). However, capex restrictions are progressively more common at each lower credit rating after BBB. Interest coverage covenants on the other hand become less prevalent at each successive lower debt rating. This non-monotonicity in the application of covenants based on cash flow restrictions suggests that these covenants hold less value for firms which have a very low or very high likelihood of default. Direct investment restrictions by contrast are most common amongst firms with the highest likelihood of default.

One notable result is that explicit restrictions on maximum leverage appear to be decreasing in financial risk, while sweep covenants are increasing. Leverage covenants specify a maximum allowable ratio of financial leverage on a going forward basis, effectively limiting new debt issues but giving the firm some additional power to issue additional debt. Sweep covenants require that some or all of the proceeds from any new securities issuance must first be used to repay the existing debt. The fact that these covenants exhibit such a striking pattern suggests that firms may prefer to avoid refinancing their existing debt where possible. Leverage restrictions should be unnecessary if the debt can be made completely senior. Moreover, even if such absolute seniority is impossible to achieve in practice, a sweep requirement precludes any senior claims from being created without first fully refinancing the existing debt.

When firms have relatively low leverage and low risk-shifting incentives, they will preserve the right to issue additional claims in the future by committing to keep leverage below a certain threshold. When the initial leverage is already high, the bank will require full repayment upon issuing any new claim. This suggests that there is some cost to refinancing existing debt claims, since firms appear to avoid these provisions when their credit situation allows them to. While the issuance of new senior claims is not explicitly modeled in our analysis, this evidence is consistent with the incentives of firms to avoid hold up problems by retaining access to investment capital.

To further examine what predicts the inclusion of cash flow and leverage covenants, we estimate a probit model for the inclusion of at least one of each particular class of covenants as a function of various firm and loan characteristics. We model the choice of each covenant as a function of firm leverage, asset tangibility, research and development expense, sales growth, profitability, market to book ratio, cash flows, and firm size. To measure the relative effects of firm specific sales growth, we also include the median industry sales growth as a control. Lastly, to measure the relative intensity of the banking relationship, we include a dummy which takes on a value of one if the firm borrowed from the same bank at least once in the last five years. This serves as a proxy for how much private information the bank is able to obtain through monitoring.

The results, presented in Table 2.4 and Table 2.5, provide strong evidence that these two types of covenant provisions are fundamentally distinct. Firms with high leverage and low asset tangibility are both likely to have both cash flow and investment covenants. However higher market-to-book increases the probability of the inclusion of cash flow covenants, while overall industry sales growth decreases the probability. By contrast, market-to-book has a negative impact on the likelihood of a capex covenant, suggesting that firms with deteriorating growth are most likely to resort to explicit investment restrictions while firms with positive growth benefit from control transfer provisions.

These results contrast with much of the existing empirical literature on covenant applications, who have generally treated covenant stringency as uniform. While leverage and asset tangibility, which often proxy for the presence of agency frictions, are both related to the inclusion of these covenants, there are also striking differences. High internal cash flows actually make the inclusion of cash flow covenants much more likely, and while industry sales growth is negatively related to the inclusion of both covenants, own sales growth has a positive and insignificant effect on the inclusion of cash flow covenants. Together with the contrasting impact of Market-to-Book ratio, this implies that uncertain future growth is an important factor in why covenants are selected.

Lastly, we note that the repeat loan indicator has a significantly positive impact on the probability of a cash flow covenant and a significantly negative effect on the probability of a capex covenant. This provides evidence for the prediction that better private information by banks increases the value of contingent control. This result is somewhat novel in the banking literature, which typically views bank monitoring as a substitute for explicit contracting and managerial discipline. In our model, bank monitoring allows for more efficient investment through the contractual use of contingent control provisions.

2.4 Conclusion

In this paper, we analyze the effectiveness of different types of debt covenants in mitigating the investment distortions caused by the agency problems associated with debt. By explicitly modeling these distortions in the context of firm control rights, we help to explain why bank debt contains both explicit investment restrictions and so called maintenance covenants which allow for bank intervention upon violation. Importantly, we demonstrate that the inclusion of covenants is not necessarily a monotonic function of firm financial risk and provide theoretical motivation for why this non-monotonicity exists.

By modeling the way in which stakeholders process information, we also shed light on how bank debt and bank relationships create value through debt covenants. We demonstrate how bank monitoring mitigates the agency costs of debt by increasing the value of contingent control. Since firm value is increased by the existence of these control provisions, closer monitoring paradoxically leads to greater use of cash flow covenants.

The non-price terms of debt contracting are an often neglected aspect of the cost of capital. In many respects, the overall cost of debt is influenced as much by its contractual restrictions and control provisions as its stated interest rate. These contractual details can tell us much about the costs and benefits of capital structure decisions and the wide variation in the choices made by firms. This paper demonstrates an important channel through which theses costs are shaped through efficient contracting. Future research in this area should provide important insights into how financing decisions are made to shape the capital structure of firms.

Table 2.1: Summary Stats

This table reports summary statistics for covenant provisions in our loan contract sample and the financial ratios of the firm at the time of the initiation of the loan. Loan covenant variables take on a value of one if the loan contract has at least one covenant in the category and zero otherwise. Total assets is reported in millions of dollars. Book leverage represents the sum of short term debt and long term debt divided by total assets. R&D expense ratio is the value of research and development expense divided by assets. Asset tangibility is the net property, plant, and equipment divided by total assets. Market to book ratio is the market value of equity divided by the book value of equity. Industry growth represents the median sales growth for each industry

	Mean	SD	10th	25th	Median	75th	90th
(1) Debt to CF Covenant	0.449	0.497	0.000	0.000	0.000	1.000	1.000
(2) Interest Coverage Covenant	0.657	0.475	0.000	0.000	1.000	1.000	1.000
(3) Capex Covenant	0.199	0.399	0.000	0.000	0.000	0.000	1.000
(4) Leverage Covenant	0.303	0.460	0.000	0.000	0.000	1.000	1.000
(5) Sweep Present	0.346	0.476	0.000	0.000	0.000	1.000	1.000
Assets - Total	2512	8531	36	106	375	1501	5401
Book Leverage	0.295	0.212	0.016	0.131	0.278	0.424	0.572
Tangibility	0.324	0.248	0.054	0.122	0.255	0.490	0.718
R&D Expense Ratio	0.020	0.048	0.000	0.000	0.000	0.011	0.066
Sales Growth	0.239	0.487	-0.103	0.010	0.119	0.313	0.672
Market to Book Ratio	1.350	0.917	0.588	0.777	1.070	1.602	2.459
Cash Flow/Assets	0.081	0.134	-0.040	0.040	0.089	0.146	0.211
Observations	7974						

Table 2.2: Correlation Table

Pairwise correlations between covenant inclusion for each class of loan covenants.

	(1)	(2)	(3)	(4)	(5)
(1) Debt to CF Covenant	1				
(2) Interest Coverage Covenant	0.451	1			
(3) Capex Covenant	0.193	0.149	1		
(4) Leverage Covenant	-0.326	0.0115	-0.177	1	
(5) Sweep Present	0.322	0.208	0.305	-0.255	1

Conditional Probabilities

Each cell represents the probability that a loan contract includes covenant from row (i) conditional on the presence of covenant in column (j) if $i > j$ and column (j) conditional on the presence of a covenant in row (i) if $i < j$.

	(1)	(2)	(3)	(4)	(5)
(1) Debt to CF Covenant	.	0.59	0.62	0.18	0.64
(2) Interest Coverage Covenant	0.89	.	0.79	0.65	0.78
(3) Capex Covenant	0.28	0.24	.	0.09	0.36
(4) Leverage Covenant	0.13	0.31	0.14	.	0.15
(5) Sweep Present	0.53	0.43	0.65	0.17	.

Table 2.3: Covenants and Debt Ratings

This table breaks loans into groups based on the S&P debt rating of the firm at the time the loan was initiated. Each cell represents the fraction of loans in each group which includes at least one debt covenant in the category.

	Debt to CC	Interest Coverage	Capex Restriction	Leverage	Sweep
A or better	0.15	0.32	0.00	0.47	0.12
BBB	0.35	0.63	0.05	0.50	0.17
BB	0.65	0.81	0.27	0.18	0.55
B	0.54	0.71	0.38	0.10	0.67
CCC or worse	0.33	0.48	0.44	0.07	0.65
N	4307				

Table 2.4: Probit Model - Cash Flow Covenants

The results of a probit model estimating the probability that a loan will include a debt to cash flow covenant. Model (2) includes the median sales growth of the industry by 3-digit sic code. Model (3) includes a dummy variable which takes on a value of one if the firm has previously borrowed from the same bank at least once in the past five years. Marginal effects at the mean of each variable are reported. Standard errors are Huber-White corrected for heteroskedasticity and clustered at the firm level.

	(1)	(2)	(3)
Book Leverage	0.359***	0.396***	0.387***
	(0.096)	(0.097)	(0.097)
Tangibility	-0.515***	-0.528***	-0.531***
	(0.094)	(0.094)	(0.094)
R&D Expense Ratio	-2.857***	-2.932***	-2.913***
	(0.461)	(0.468)	(0.467)
Sales Growth	0.0333	0.0704	0.0710
	(0.035)	(0.038)	(0.038)
Market to Book Ratio	0.0749***	0.0771***	0.0769***
	(0.022)	(0.023)	(0.023)
Cash Flow/Assets	1.837***	1.884***	1.847***
	(0.169)	(0.174)	(0.174)
Log(Assets)	0.0279*	0.0304*	0.0124
	(0.012)	(0.012)	(0.012)
Industry Sales Growth		-0.622***	-0.635***
		(0.158)	(0.158)
>1 loan in last 5 years			0.175***
			(0.033)
Constant	-0.451***	-0.404***	-0.365***
	(0.084)	(0.088)	(0.089)
N	7974	7675	7675
r2			

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.5: Probit Model - Capex Covenants

The results of a probit model estimating the probability that a loan will include a capex restriction. Model (2) includes the median sales growth of the industry by 3-digit sic code. Model (3) includes a dummy variable which takes on a value of one if the firm has previously borrowed from the same bank at least once in the past five years. Marginal effects at the mean of each variable are reported. Standard errors are Huber-White corrected for heteroskedasticity and clustered at the firm level.

	(1)	(2)	(3)
Book Leverage	0.626***	0.621***	0.626***
	(0.099)	(0.100)	(0.100)
Tangibility	-0.576***	-0.579***	-0.581***
	(0.092)	(0.096)	(0.096)
R&D Expense Ratio	-0.914*	-1.275**	-1.278**
	(0.456)	(0.466)	(0.465)
Sales Growth	-0.225***	-0.169***	-0.169***
	(0.051)	(0.050)	(0.051)
Market to Book Ratio	-0.122***	-0.106***	-0.105***
	(0.029)	(0.029)	(0.029)
Cash Flow/Assets	-0.534***	-0.458**	-0.434**
	(0.147)	(0.151)	(0.151)
Log(Assets)	-0.0897***	-0.0951***	-0.0816***
	(0.010)	(0.011)	(0.011)
Industry Sales Growth		-0.857***	-0.851***
		(0.185)	(0.185)
>1 loan in last 5 years			-0.130***
			(0.039)
Constant	-0.0659	0.174	0.145
	(0.083)	(0.089)	(0.090)
N	7974	7675	7675
r2			

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.5 Supplementary Proofs

2.5.1 Proof of existence

The following proposition establishes existence of levels of the initial investment k_0 and c_L which will correspond to realizations of δ for each of the regions discussed in the paper.

Proposition 2.5.1. *Under equity control, debt face values of at least $F = c_L + \frac{5}{4}$ are possible as long as financing is feasible.*

Proof. Since the face value of debt F is decreasing in c_L an c_H, the largest possible face value occurs when $c_H = c_L = c$. For $k_0 < c_L + 1$, the debt will be risky, and the value of debt will be given by

$$\frac{1}{9}\left(-2 - 2c^2 + (5 - 2F)F + 4c(1 + F)\right)$$

Setting this value equal to k_0 gives a face value of debt $F = \frac{1}{4}\left(5 + 4c - 3\sqrt{1 + 8c - 8k_0}\right)$. This is feasible for any initial investment k_0 such that:

$$-1 + c < k_0 \leq \frac{1}{8}(1 + 8c)$$

The upper bound on k_0 implies a face value of $F = c + \frac{5}{4}$. As c_H increases, higher values of c_H can support higher face values of debt and increasing $F - c_L$ $\square$

2.5.2 Proof of Proposition 2.2.4

Proof. We first solve for the simplest case, where $c_H = c_L + \epsilon$ where ϵ is vanishingly small. In this case $c_H \approx c_L$, but the realization of c_L is contractually distinguishable from c_H. For $k_0 < c_L - 1$, the face value of debt is exactly k_0 and the debt is therefore always safe. Equity holders always make the first best investment decision.

For $k_0 > c - 1$, the debt is risky. First conjecture a k_0 such that $-1 < F - c < 0$. The face value of debt under equity control, ($k = \frac{4}{3} - \frac{1}{3}(c_L - F)$), is given by

$$\begin{aligned} \frac{1}{9}\left(-2 - 2c_L^2 + (5-2F)F + 4c_L(1+F)\right) &= k_0 \\ \Leftrightarrow F &= \frac{1}{4}\left(5 + 4c_L - 3\sqrt{1 + 8c_L - 8k_0}\right) \end{aligned}$$

This gives an expected value of the follow-on investment of

$$\Leftrightarrow \frac{1}{16}\left(3 - 4c_L + 3\sqrt{1 + 8c_L - 8k_0} + 4k_0\right) \tag{2.21}$$

If the control over the follow-on investment is given to the bank upon the realizing c_L, the investment $k(c_L) = F - c_L$. The face value of debt when control switches to the bank at c_L is given by:

$$\begin{aligned} \frac{1}{36}\left(-4 - 13c_L^2 + 28F - 13F^2 + c_L(8 + 26F)\right) &= k_0 \\ \Leftrightarrow F &= \frac{1}{13}\left(14 + 13c_L - 6\sqrt{4 + 13c_L - 13k_0}\right) \end{aligned}$$

This gives an expected value of the follow on investment of

$$\frac{2}{169}\left(-65c_L + 6\left(2 + \sqrt{4 + 13c_L - 13k_0}\right) + 65k_0\right) \tag{2.22}$$

The inequality implied by equation (2.21) and equation (2.22), gives a threshold cash flow value of $c_L = \frac{1}{9}(10 + 9k_0) - \frac{68\sqrt{2}}{81}$. For cash flows above this value, the loss due to over-investment by the equity holder when he is in control outweighs the loss due under-investment when the bank is in control.

$\square$

2.5.3 Proof of Proposition 2.2.8

Proof. We first prove that the threshold value of c is decreasing in p_E.

From Lemma 2.2.5, the investment decision of the firm is determined by the threshold $\beta^* = \frac{4-\delta+p\delta-4\sqrt{-p(-2+p-\delta+p\delta)}}{3-3p}$. For all possible signals $\beta^* < \beta < 2$ the expected value of the follow on project will be $p_E(\beta) + (1 - p_E)(\beta - \frac{1}{2}\beta^2)$. For all possible signals $0 < \beta < \beta^*$, the expected value of the follow on project will be $p_E\left(2\beta - (\frac{4}{3} - \frac{1}{3}\delta)\right) + (1 - p_E)\left(\frac{1}{18}(4 - \delta)(2 + \delta)\right)$

This gives an unconditional expectation for the value of the follow on project, prior to the realization of the signal, as follows:

$$E(V) = \begin{cases} \frac{1}{3}(1+2p) & \text{for } \delta \geq \delta^* = \frac{4+8p-\sqrt{48p(2+p)}}{1-p} \quad (2.23) \\ \frac{1}{324(p-1)^2}\Big[124 + 24\delta - 15\delta^2 + 2\delta^3 - \\ \quad 6\left(16 + 8\delta + 2\delta^2 + \delta^3\right)p + \\ \quad 3\left(196 + 88\delta + 23\delta^2 + 2\delta^3\right)p^2 - & \text{for } \delta < \delta^* \quad (2.24) \\ \quad 2\left(36 + 120\delta + 21\delta^2 + \delta^3\right)p^3 + \\ \quad 32(-7+\delta)p^{3/2}\sqrt{2+\delta-(1+\delta)p} - \\ \quad 32(10+\delta)p^{5/2}\sqrt{2+\delta-(1+\delta)p}\Big] \end{cases}$$

From equation (2.24), the value of the investment is 0 when $\delta = -2$ and is increasing in δ up to $\delta^* > 0$.

From Lemma 2.2.6, the value of the follow on investment under bank control for $-2 < \delta < 0$ is given as:

$$E(V) = \frac{1}{12}\left(-12\delta - 9\delta^2 + 6p\delta^2 - 2\delta^3 + 2p\delta^3\right) \tag{2.25}$$

The value of the investment is 0 when $\delta = 0$ and is decreasing in δ. This establishes a crossing condition for the two values. Since the value under equity control is increasing in p_E for all δ and the value under bank control is decreasing in δ, the threshold realization of $c = F + \delta$ must also be decreasing in p_E.

By extension, since the value under bank control is increasing in p_B and the value under firm control is increasing in δ, the threshold realization of c must be increasing in p_B.

□

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